SCIENTIFIC AMERICAN

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IMPROVED HORIZONTAL TESTING MACHINE.

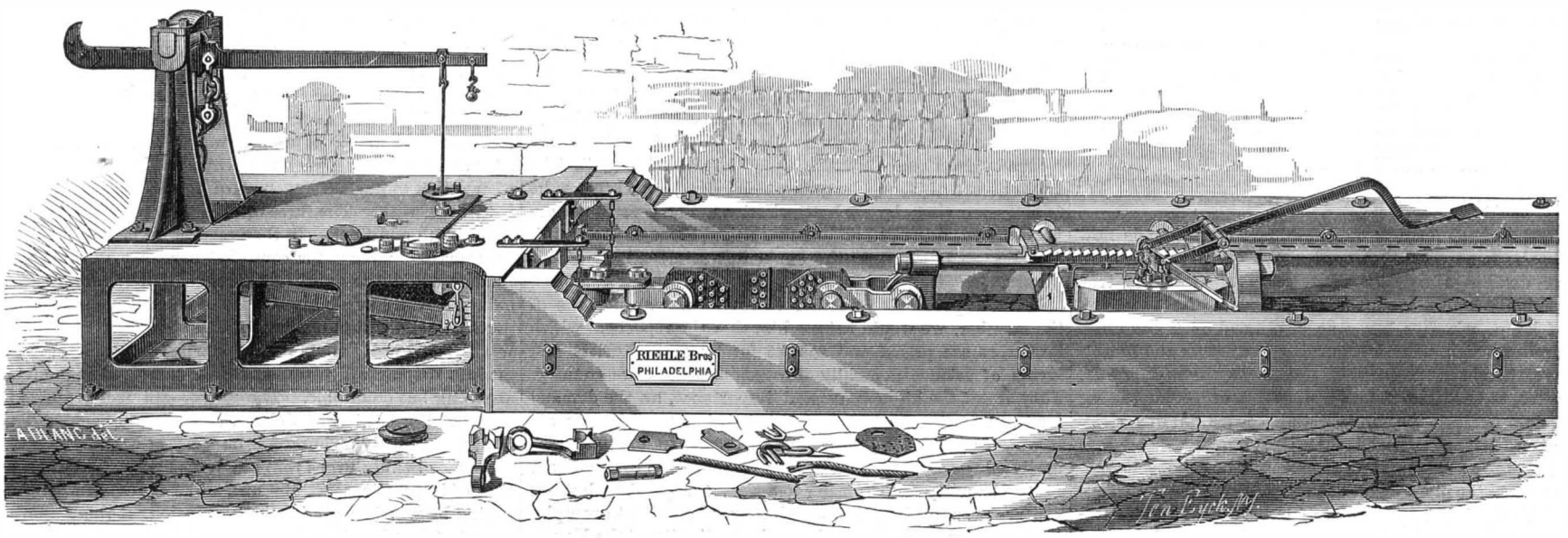
We illustrated in a former number one application of Riehle's method to testing the strength of metals, rope, etc. Our present engraving refers to a novel device on the same principle, which, however, in addition to other advantages, allows of experiments being made not only upon small fragments of material, but on pieces of considerable length.

The machine represented is of 75 tuns capacity. At one end, enclosed in an iron frame, is a heavy intermediate lever, the upper fulcrum of which bears against a plain steel surface composing a part of the iron frame, accurately and firmly inserted. The lower fulcrum presses against the clevis that connects directly with the tools that hold one end of the test specimens. This intermediate lever is suspended at the larger end by clevises that swing from the iron frame, and at the smaller end from a compound parallel crane beam, that rests upon pedestals. Upon this parallel beam is an ordinary weight dish upon which U. S. standard weights are placed to weigh the strain that the test piece is being subjected to; one pound on the weight dish indicates a strain of one thousand pounds on the test specimen. At the other end of the machine is a hydraulic jack and pump, which are placed upon low, strong wheels and run along a railway; they are stopped at any desired point, by means of keys dropped into slots about 10 inches apart in the railway; this is in order to accommodate the length of the test piece, which might be but a few inches, and can be a hundred feet long or more. The power is applied merely to take up the slack, but the strain is weighed and even broken by the weights being placed upon the weight dish on the crane beam, which must be kept parallel by the use of the power and weights together. The equipoise of the beam is indicated by means of a finger point that must vibrate freely when the proper weight is applied. This is clearly shown in the engraving, between the pedestals. When the test piece is in position, the lever and beam must be balanced by means of the balance cup hanging from the extreme end of the parallel beam. All the bearings and fulcrums are steel, made very strong and true, and as each part swings perfectly plumb, there is no friction, so that a strain upon a specimen can be weighed to within a few pounds. The operation of the jack and pump is as follows: The handle of the pump being operated, the plunger of the jack is forced out horizontally, and is connected with the tools that are fastened to a cross head by means of two bolts. In order to get the plunger back again, a lever is raised which catches in a ratchet, and which, when pressed down, forces the latter back again; this operation also sends the fluid back from the jack into the pump reservoir. The iron frame and the timbers that support the iron guides are all firmly secured to a foundation of masonry.

The machine represented in the illustration, which is straining a piece of double riveted boiler plate, was built for the purpose of testing chain, wire, and hemp ropes, also bridge bolts and boiler plate, and is ninety feet long when put up for use. The construction of the device embodies certain principles, that can be modified indefinitely and adjusted to apply any desired strain, to any material, in any shape or form—including the crushing resistance of iron or stone columns, transverse strain of girders, and torsional strain.

The principal merit of this apparatus, in addition to its evident compactness and strength, is its simplicity. It will be noticed that, by using the parallel crane beam and a single counting or multiplying lever, any elaborate construction or multiplication of leverages, causing so much to depend upon mere calculation, is dispensed with. Instead of a number of fulcrums, two main fulcrums bear the whole strain, and these being made in certain lengths, according to a regular rule, obviate any danger of the crumbling of fine bearing points.

For further particulars address Riehle Brothers, No. 93 Liberty street, New York city, or North street, below Coates, Philadelphia, Pa.



RIEHLE'S HORIZONTAL TESTING MACHINE.

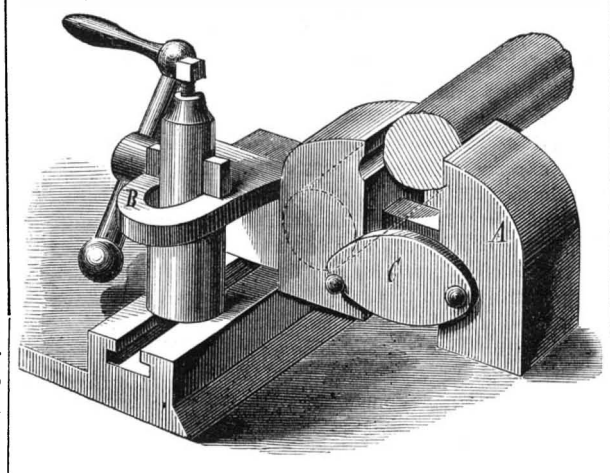
A New Language for Japan.

M. Mori, the Japanese *chargé d'Affaires*, has written a remarkable letter to Professor Whitney, the distinguished orientalist at Yale College, in which he states that the present language of Japan is inadequate; and that it is the opinion of the best educated men and most profound thinkers of that country that, in order for their nation to keep pace with the age, some copious, expansible European language must be adopted, which must be taught in the schools and gradually made the common vernacular. The present Japanese dialect is merely a spoken one, having little or no relation to the written language, which is a corruption of the Chinese.

The English language, the writer states, would be adopted in preference to another tongue, were it not for its many irregularities and the absence of law, rule, or order in its orthography. Mr. Mori's idea is to invent a new language or, rather, a modification of an old one. In other words, he proposes to compile spelling books, dictionaries, grammars, and other text books teaching what may be termed "simplified English." The forms "speaked, bited, thinked, buyed, comed, beared," will be substituted for the commonly received preterites and participles, and all plurals will be made regular. Spelling will be reduced to a purely phonetic basis, and in fact the entire language will be recast.

LATHE VISE.

Mr. J. B. Low, of Ravenna, Ohio, has patented the accompanying convenient form of lathe vise, which may be used



in connection with the lathe tool carriage, either as a rest for bolts while cutting threads upon them, or as a holder for drills and other lathe tools in ordinary use. It also provides a rest for the bolts while they are held by the instrument, which will adjust itself to the varying diameters.

The vise is of ordinary construction, A being the movable jaw. The slotted lug, B, on the stationary jaw holds the tool post, as shown. The inner sides of the jaws are provided with transverse grooves, which form a bearing surface, the circular object held therein having its center in line with them. C is a plate pivoted to the jaw, A, and its opposite end rests on an offset on the stationary jaw. The circular bolt held in the vise will therefore be supported as indicated by the dotted lines at three points, the grooves and the upper edge of the plate, C. These parts maintain the same relative position to whatever extent the jaws are separated, the free end of the plate, C, dropping as the jaws recede, and *vice versâ*, thus lowering or raising its upper edge in proportion to the separation of the jaws.

Deacon's Chlorine Process.

It is well known that, by Deacon's process (described on page 73 of our volume XXVII.), chlorine is made directly from muriatic acid, without the intervention of manganese dioxide. It is justly regarded as one of the most important technical improvements of modern times. At a recent meeting of the Leipsic Polytechnic Club, the subject came up for discussion, and some interesting facts were elicited. Dr. Gruneberg remarked that much depended upon keeping the temperature of the furnace constantly at 700° Fah., and this point was carefully observed by the inventor. It was also found necessary to dry the chlorine to insure a high grade of bleaching powders. This was accomplished in some factories by using chloride of calcium, and in others by substituting sulphuric acid. Deacon's process was highly prized in England for economical and sanitary reasons—the escape of muriatic and chlorine vapors into the air was avoided, and the costly black oxide of manganese was dispensed with. The great cost attending an entire change in the construction of the manufactories of bleaching powders has stood in the way of a general introduction of the process into Germany. All of the old chlorine retorts are useless, and the floors for the lime must have ten times as much surface, owing to the dilute condition of the chlorine. In England, however, many establishments have adopted the new method, and it appears likely to supersede all others. Dr. Hurter was mentioned as the chemist who had studied the chemical reactions of the process, and he had been of great assistance to Deacon. It was stated by Dr. Glaser that there was a larger consumption of fuel in Deacon's process; but, as the costly manganese falls out, this objection was considered as overruled.

Detection of Small Quantities of Titanium.

For the detection of small quantities of titanium, Mr. Apjohn recommends to fuse 12 grammes of the finely pulverized mineral with six times its weight of acid sulphite of potash, until all of the free sulphuric acid is expelled. Pulverize the cold mass, exhaust with water and boil the highly diluted aqueous solution in sulphite of soda. As soon as the precipitation is complete, allow the liquor to cool and pass a little sulphurous acid through it to dissolve any small traces of iron or aluminum that may have been thrown down by the previous operations. The precipitate of titanic acid thus obtained can serve for the preparation of any of the salts of titanium. It is an interesting fact that titanic acid readily absorbs nitrogen, and upon this property Du Motay has founded a method of making ammonia directly from the air.

The Territory of Oklahoma.

A bill is now before Congress for the organization of a new territory, under the above name, out of lands now pertaining to the Indian territory.

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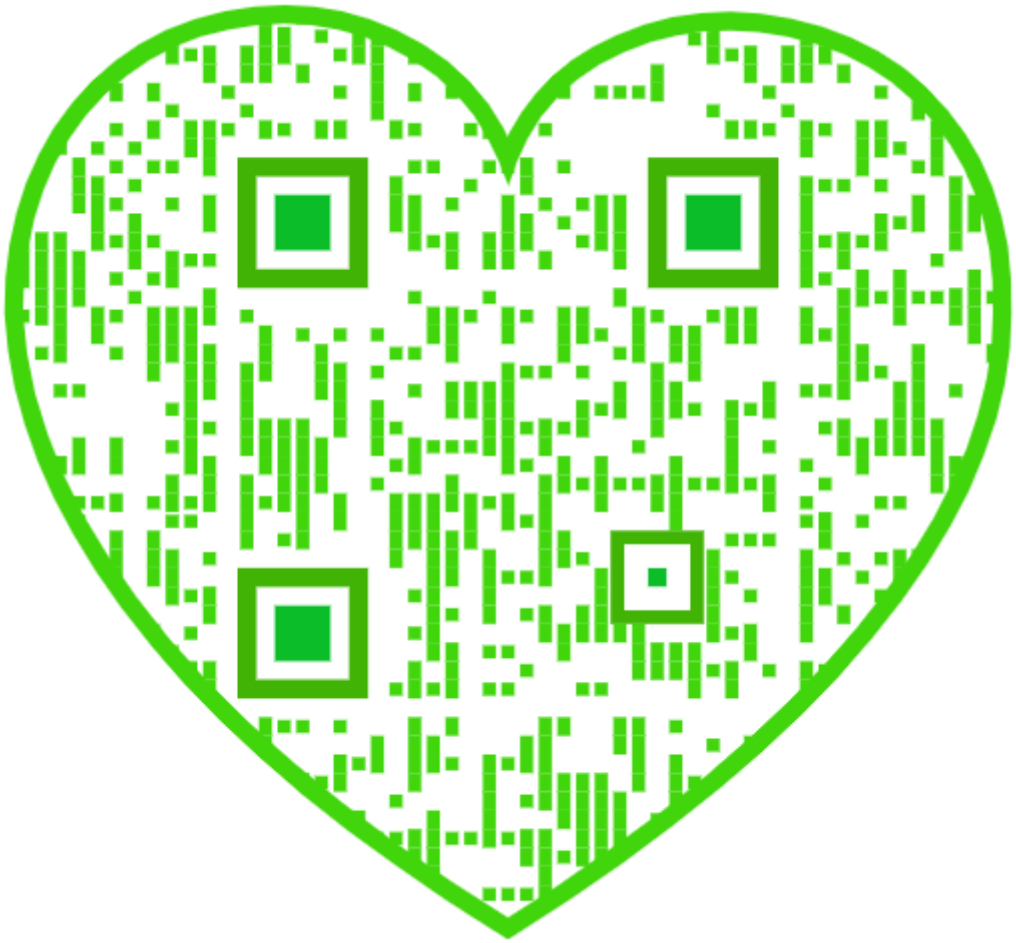

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GAS LIGHT AND STEAM HEAT.

The question of heating our buildings by steam is now about in the same condition as was the question of lighting our dwellings by gas fifty years ago. It is true that gas is the safest kind of light, much safer than any kind of lamp, whether kerosene or oil, and even more safe than candles, which, when left burning in a corner and forgotten, have often been the cause of fire. Notwithstanding this, there were, at the time mentioned, scores of people raising their voices against the introduction of gas in our cities and houses; they declared that we should not be safe against fires for a single moment, that such combustible material as gas in the pipes under our floors, connected with large reservoirs containing thousands of cubic feet of the inflammable stuff, was worse than a gunpowder magazine; that a city possessing gas works was subject to the risk of blowing up at any moment, that a house using gas was especially unsafe, and that insurance companies would not or could not insure such a building; and a few single instances of accidents caused by the careless or ignorant use of gas were pointed out as proofs of the soundness of the fears of the alarmists.

We have now exactly the same kind of alarmists among us, who, notwithstanding that heating buildings by steam is the most safe of all methods, far surpassing the hot air furnaces and infinitely safer than having a separate fire in each room, raise their voices against steam heat, and attribute every fire, taking place in a locality where steam is used, not to the fire in the furnace, or any other cause, but to the steam, making the pipes red hot and so igniting the wood work in the neighborhood of these pipes. In order to sustain this theory, they have taken refuge in the fact that when steam has been very highly superheated, that is, passed through an extensive superheating apparatus (which essentially consists of a series of pipes, laying in an actively burning furnace) and thus raised in temperature to a bright red or white heat, it may, under certain circumstances, heat the tubes through which it afterward passes to such a temperature that the pipes become dangerous to woodwork. They overlook the fact that, in none of the boilers used to heat buildings, do the conditions necessary to superheat the steam exist to such a degree as to become dangerous; while in the great majority of boilers the steam is not superheated at all.

In expressing our opinion, as we have repeatedly done, in regard to the impossibility of igniting wood by steam, we of course had only in view the practical side of the question, the existing boilers in actual use for heating buildings, and not steam proceeding from extensive red hot coils passing through furnaces, and, for instance, used for distilling or heating substances to temperatures far above that of the steam found under all other circumstances. If those who appear so convinced of the ease with which steam will heat iron pipes, to such a degree as would become dangerous for wood work, would take the trouble to try what they can themselves accomplish in this line, they would (in case they have no other object in view than to know the truth in this matter) soon become convinced that it is not so easy to get the temperature up to the required degree, that alleged results are highly exaggerated, and that the formation of superheated steam with the fires banked or withdrawn is a gross illusion without any foundation in fact. Banked fires are themselves a source of danger, as by shutting off the draft and access of air, there may be a greater amount of combustible gases generated than the accessible air can consume; this imperfect combustion gives rise to a mixture of two gases, some unburnt hydrocarbons, and imperfectly burned carbonic oxide, in place of carbonic acid, to which the gas burns under free access of sufficient air. When such gas, by reason of having the draft shut off, passes out of the furnace doors into the boiler room or engine room, it will be ignited by the fire itself, or by being hot enough to burn when coming in contact with air, in the same way as we often see by night the flames flaring out of the tops of the smoke stacks of our river steamers, and as is often observed in our furnaces and cooking stoves when suddenly opening the doors; some of the latter have been improved in this respect by holes admitting air over the fire, and are thus called gas-consuming stoves.

We hold that it is much more probable that Barnum's museum took fire from such a cause than that, according to the Fire Marshal's theory, the banked up fires made the pipes in the upper part of the furnace hotter than the fire did when the full draft caused an active combustion.

ENTOMOLOGY IN CONGRESS.

Our legislators in the House of Representatives have placed on record a very amusing debate over the question of increasing the appropriation for the Department of Agriculture for the coming year. The argument took place during the discussion of the Legislative Appropriation Bill, and the opportunity was seized by several members to explain at length what they did, or, more correctly, what they did not know on the subject of scientific agriculture. For Mr. S. S. Cox, of New York, was reserved the distinction of delivering an effusion which deserves a prominent place in the comic literature of the country. With a narrow mindedness which we would fain believe did not arise from ignorance, the gentleman took occasion to hold up to public ridicule subjects which, because they were beyond his faculties of comprehension, he evidently inferred exceeded the reasoning powers of every one else. After humorously adverting to the department in general, he singles out the entomological report as a target for his wit. "God help us to a faithful lexicon," he rather irreverently observes, and then brings down the House by facetiously alluding to a "bureau of bugs." The Latin names of insects he quotes *ad libitum*, and, because he is unaware that, by such appellations, the possessors are best known, described and distinguished through the world, free license is given to the exuberant scintillations of his humor.

Without proceeding further to review the absurdities of the member, we would inform him that the reports at which he sneers are prized and sought for by agriculturists and lovers of science generally throughout the entire country. They are of the highest use and importance, as the demand for them testifies. And as for their being recondite or abstruse, we cannot find anything in them that any one ordinarily educated in natural science would fail to comprehend. It may be witty and amusing to make such speeches, but we venture to suggest that, although they are excellent examples for stump oratory, they are beneath the dignity of the House, while they are far from calculated to foster public interest in a young and valuable department which needs and richly deserves the utmost popular support.

The discussion of the question of treating so indispensable an office as that of microscopist, involving a salary of $1,800, and that of raising the pay of the Commissioner of Agriculture a couple of thousand dollars a year, fills nearly an entire page of the *Globe*. The expediency of devoting this trivial sum to purposes of direct national advantage occupied the attention of the House for hours, and the increase of salary to the commissioner was in the end refused. It is a suggestive fact that the same body, with half the discussion, devoted fifty times the pittance asked to satisfy the demands of a few useless officials and to advertise a number of private individuals at the Vienna show. It is a strange policy that refuses hundreds for the national good and devotes thousands for purposes of private gain.

THE VIENNA SHOW IN THE SENATE.

The Senate has at length taken action upon the Vienna Appropriation bill. The amount to which the sum devoted has been raised, together with the further expense involved by the amendments which have been added to the original act, of which but the form has been retained, authorize, we confess, a rather more wholesale raid upon the Treasury than we anticipated; but it is probable that some reliance may be placed upon the Lower House to curtail the extravagant proportions which the measure has assumed.

The bill passed by the House provided for the appropriation of $100,000, and authorized the President to appoint twelve skilled artisans to report upon the Vienna show. As returned by the Senate, it devotes $300,000, calls for the selection of seven scientific men and eight skilled artisans, whose expenses, not to exceed $2,000 each, are to be paid from the above fund, and who shall report, etc., and it authorizes the designation of one hundred assistant commissioners, who, strange to say, are to receive no compensation. Senator Schurz, of Missouri, opened the discussion by presenting the favorable report of the Committee on Foreign Relations, and was supported by Senators Cameron, Hamlin, Morton, and Sprague. In opposition, Senators Chandler, Saulsbury, Casserly, and Trumbull conducted the debate. As usual, the exhibition certificate was again declared to act as a full patent, and the misconceived interpretation placed upon its provisions by the Commissioner was once more brought forward. This we have repeatedly disproved; further asseveration is useless. The facts that we are to have an Exposition of our own before long, and that nations are like individuals—if we do not go to their festivities, they will retort by refusing to come to ours—were frequently reiterated and special stress was laid upon "the great many objects for which the money is to be expended." Happily, the latter are for the first time in the history of the controversy enumerated, and the following list is, as stated by Senator Schurz, derived from "gentlemen connected with the commission." "First, office expenses of our commission in New York; freight from Trieste to Vienna, and back; unpacking and installation of goods; guards, interpreters, local commissioners, and general office expenses at Vienna; exhibition tax for place occupied in building; the building of foundations for our machinery; advertising, catalogues, circulars, insurance, free packing, and returning goods to exhibitors; cost of scientific commission to visit and report on the exhibition; printing and circulating reports of scientific commission; salaries of Commissioners; separate structures in park for agriculture, schools," etc.

After perusing this list, we have only to express our wonderment that so modest a sum as $300,000 has been considered sufficient to meet so varied a category of expenses. More astonishing still is it, however, to contemplate the present proportions of the plan in connection with the original act which was passed in Congress in June last. We commenced with a simple bill of a few lines authorizing the President to appoint one or more agents (nothing is said about "Commissioners-General") to represent the United States at Vienna, with a distinct proviso "that such appointments *shall not impose upon this Government any liability for the expenses which they* (the agents) *may occasion.*" Here was no outlay; it was affirmed that the act was intended merely to confer a little dignity on gentlemen who wished patriotically to benefit the country. Now we are to pay for free transportation of exhibited articles; pay not only the Commissioner, but his assistants, large salaries; pay for the buildings in which our goods are to be placed; pay for a scientific commission, and even pay to insure and set up the very machinery that we go to all this expense to transport. Why not continue, and buy the goods out and out, and pay the exhibitors at once for going to Vienna? As Senator Trumbull said, it is safe to predict that a million of dollars will be taken from the Treasury and be assessed upon the people of this country by way of taxation to pay the expenses of this Exposition before it is through with. The farce of the Paris show is to be re-enacted, with additions. In that case as in this, after we had appropriated money for commissioners, we devoted a still further amount to build houses to contain our articles. We gained nothing beyond half a dozen volumes of scientific reports now difficult to obtain, a grand advertisement for a few wealthy and well known manufacturing firms; and, after all, made a display which was so badly managed as to make it anything but creditable. The unpleasant fact remains that over a half a million of dollars, according to Senator Trumbull, was directly disbursed from the National Treasury.

Senator Schurz urges that our ideas strike down the whole plan of international exhibitions. We cannot trace the reasoning by which he attains this conclusion. If this Exposition were to take place in a country which had a code of laws not clearly oppressive and unjust; if inventors could acquire its benefits without more than compensating for them by the loss of their rights; if, in short, it even produced upon the people of this nation the effect which such enterprises are designed to have, and that is, to awaken the industrial classes to new efforts, to stimulate them to rely on their own excellences and not to turn supinely to a fatherly government for help, we should be the last to call up any opposition. But when, as is manifestly now the case, it is proposed to tax a nation already overburdened for the benefit of a few: when, under cover of a disinterested patriotism, every possible effort is made to deplete the Government Treasury; when, to gratify a feeling of false national pride, we are asked to be contented with such reasons as "we ought to be liberal," when we are without the means to pay our just debts: "encourage immigration" when foreigners from almost the vicinity of Vienna are pouring in by every steamer in such numbers that our local charities can barely keep them from starving in the streets: "advertise our products" when the same are already thoroughly known throughout Europe: or "conciliate Austria" when that country has fairly insulted us by ignoring our request for even a modification of her unjust code: then we, as a journal striving for the public welfare, together with our legislators in Congress who have the true interests of the country at heart, do but advocate the right in opposing a measure which, if not prejudicial, is plainly of no benefit to the nation at large.

THE OCEAN TIDES AS A PRIME MOTOR.

The power of the ocean tides is the only power on earth due directly to gravitation. All other powers are obtained by the intervention of solar heat, which causes the watery vapors to ascend. These, returning as rain, are the cause of the rivulets, rivers and all water power. Solar heat also causes the unequal expansion of the air and so gives rise to air currents, or winds, which drive our sailing vessels and windmills. Again, the solar heat causes vegetation to flourish and so produce combustible material, which is used either fresh, as wood, or from the inexhaustible deposits, stored up in geological periods and transformed by age and circumstances into coal, petroleum, asphaltum, etc. The heat of this fuel is, in appropriate engines, changed into motion, or certain products of vegetation are consumed by animal bodies which, in return, may be utilized as moving forces; or, lastly, the solar heat may be directly employed to move machinery, a problem to which it appears that Captain Ericsson the well known inventor of the caloric engine, the monitors, etc., appears now to have devoted the rest of his life.

Indeed, whichever way we turn, we see that all life and all motion on the surface of our earth, with the sole exception of the ocean tides, may be traced back to the heat of the sun as primary cause; and the power we may obtain from the tides is due to the combined attraction of the sun and moon. In

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vestigations in this regard have shown that the original tide wave is generated in the Pacific Ocean, and that this wave moves westward with the apparent motion of sun and moon, one wave following the sun and another the moon, but as the apparent motion of the latter body is slower, the lunar wave is continually overtaken by the solar wave; if the whole equatorial belt of our earth were water, the solar wave would make the revolution around the earth in 24 hours, while the lunar wave would accomplish this in a little over 25 hours. As it is, however, the continents of Africa and America prevent this regular flow of tides, and the Pacific tide waves have to go around the Cape of Good Hope, and thence spread northward through the Atlantic Ocean. Any gulf having a funnel shaped mouth, placed in the right direction, will increase the hight of the tide entering it; this is the case with the Bay of Fundy and the Red Sea; and all gulfs having a narrow entrance not placed in the right direction will have a tide wave of much less hight than that in the free ocean; such is the case with Chesapeake Bay and the Baltic Sea. Different forms of the coast and its direction will exert a similar influence; while the greatest divergence will be reached where the tide wave reaches any place from two sides, as is often the case behind large islands. The effect will be then, of course, to increase the hight, if the high or the low tides coincide, while the hight will be diminished and even the whole tide neutralized if the high tide wave, coming from one side, coincides with the low tide from the other side.

It is thus not at all surprising that the tides are so different in different localities. In the Bay of Fundy the difference between the ordinary high and low tide is 70 feet; at the mouth of the Severn, England, and at St. Malo, France, it is 46 feet; at Guernsey and Jersey 36 feet; at the mouth of the Scheldt 20 feet, along the coast of Holland 10 to 16 feet; along the coast of the United States the tides vary from 4 feet to 10 and 20; while in the Mediterranean they are scarcely perceptible.

To estimate the power of the tides, we have only to consider that the attraction of sun and moon elevates the surface of the ocean to a mean hight of about two feet; this happens twice in 24 hours, and we may then set down the extent of surface thus raised at half the surface of the earth, of which the ocean occupies three quarters. We have then 100,000,000 square miles of water 2 feet thick; every square mile of water of this thickness contains nearly 60,000,000 cubic feet, or 3,840,000,000 pounds of water, and this multiplied by 100,000,000 (the number of square miles affected by the tide) gives the enormous number of 384,000,000,000,000,000 of foot pounds exerted every 12½ hours, or 750 minutes, which is 500,000,000,000,000 foot pounds per minute; dividing this by 33,000 to reduce it to horse power, we obtain more than 15,000,000,000 horse power for the mechanical value of the tide wave over the whole surface of the earth; of which, however, only a comparatively small portion can be utilized, namely, that within reach of sea coasts along continents and islands.

Such an enormous power, due to the combined action of the solar and lunar attraction and the terrestrial rotation, must have its influence on this rotation, and this is the theoretical problem for the future astronomer; while the method of utilizing this enormous power is the practical problem for the future engineer and mechanic.

BALANCING MACHINERY.

In a recent article we stated the principles involved in the balancing of machinery, whether a standing or a running balance, or both combined, was desired. We have now a few remarks to make relative to the application of those principles.

It is evident that, in introducing a counterbalance into a machine, to secure the best result such an arrangement should be effected that the new forces introduced should be not only equal in intensity to the forces to be counterbalanced, but that the two forces should act, at all times, in opposite directions along the same line. A piece rotating about an axis should be counterbalanced by another piece directly opposite, moving in the same path. A reciprocating piece, like a piston, should be counterbalanced by another heavy piece moving with equal and opposite *vis viva* in the same line. This is sometimes impracticable, however. A pulley or fly wheel can usually be either rendered symmetrical by carefully turning up, or it can be counterbalanced by added weight, on the light side and precisely opposite the point at which the center of effort of the excess is found. A crank can generally be counterbalanced by adding a piece of proper weight and shape, cast or otherwise secured to its hub, directly opposite the eye of the crank. It seldom happens, however, that the effort of the counterbalance required to neutralize the strains and jars due to the reciprocation of the piston of a high speed engine can be made to act in the center line of the cylinder; and it not unfrequently happens that cases occur in which the counterbalancing of rotating parts must be effected by adding the new weight at a point on the opposite side of the shaft, but not in the same plane of rotation. In such cases, although the tendency of the shaft or of the machine to shake bodily, backward and forward or upward and downward, is destroyed, and although the result is, in very many cases, found satisfactory, a new action is introduced which requires examination; for, after passing a limit of speed which must be determined for each individual case, it also may give rise to inconvenience or even danger. The case of the balance wheel set with its plane at an angle with its shaft will serve as an excellent illustration of the general case. Here, while the shaft is rotating, every particle in the wheel is balanced by a particle, of exactly equal weight and of equal *vis viva*, on the opposite side of the shaft.

Every particle whose centrifugal force acts upward has a companion particle diametrically opposite in the wheel, whose centrifugal force acts downward; and every particle tending to draw the mass to the right is similarly counteracted by a particle tending to the left. In only one set of particles, however, in that set lying in the one line which can be drawn as a diameter of the wheel at right angles to the line of the shaft, are these actions in opposite directions along the same line. All other pairs of particles pull in opposite directions but not in the same line, and they all tend to pull the fly wheel around until its shaft becomes vertical to the plane of the wheel.

This disposition of one set of forces, by which they tend to produce a rotation about some center while having no tendency to produce a motion bodily in any direction, is called, in the science of mechanics, a "couple."

In our illustrative case, therefore, and also in all similar cases of counterbalancing, as we stated in our reply to a correspondent, if the system "is accurately balanced and is perfectly symmetrical," there will always be a tendency "to turn until its plane shall take a position at right angles with the shaft. This effort will be a constant one, tending to bend the shaft, and does not necessarily produce unsteadiness in the shaft." Yet, although this arrangement is in principle often met with and may generally be found satisfactory, there will always be a limit of speed, beyond which unsteadiness will exhibit itself in the twisting effect which we have noticed.

The shaft and its supports, although not carried bodily in any direction, will have a tendency to oscillate about some point as a center. This action should, of course, be carefully avoided where great speed of revolution is contemplated.

Our final conclusion is, therefore, that in any piece of machinery, perfect steadiness may be secured, whether at rest or at high speed, by so designing it that every particle may be balanced by another of equal and opposite moment, of equal and opposite *vis viva*, and so placed that the opposing forces may not produce a couple.

THE DUPLEX TELEGRAPH INSTRUMENT IN ENGLAND.

An alleged important discovery in Telegraphy is just announced in England, consisting in a device said to be original with Mr. Preece, the Postal Telegraph Engineer. It consists in an arrangement of instruments for sending messages in both directions at once by the use of one wire.

This is an American improvement, invented here some years ago, by J. B. Stearns, and by him patented. It has been in use on the lines of the Western Union Telegraph Company in this country for a considerable time, with much success. It doubles the transmitting capacity of every telegraph wire, and is regarded here as one of the most important inventions that have been made since the introduction of the electric telegraph system.

We are glad that our British cousins have at last waked up to an appreciation of its value, even if they credit the discovery to the wrong individual. It might be well for the British telegraph authorities to send over here for a few hundreds of the Stearns machines and put them into use at once; thus immediately doubling the capacity of their wires, and saving them from further experimentation upon the subject

WHAT IS THE USE?

The first question usually asked by the average member of society on hearing of an important discovery is: "What is the use?" If this is not answered in a satisfactory manner, the subject is at once dismissed as unworthy of consideration. We were lead to reflect upon this propensity, to underrate scientific discovery unless an immediate use could be found for it, the other evening when listening to Professor Tyndall's exposition of the laws of light. Newton's analysis of light by passing a beam through a prism was a discovery of no apparent value at the time it was made. The spectrum was very beautiful to look upon, but few persons could understand or appreciate it. No one could have anticipated that this was the germ of a method which would gradually lead to the discovery of new metals on our earth, to a study of the atmosphere of the sun and planets, that minute quantities of substances would be detected by it in mineral waters and rocks, that steel would be manufactured by watching the light produced by burning gases, that an instrument called the spectroscope would become one of our most important adjuncts in the study of astronomy, in technical researches, in the detection of new bodies; and thus the ray of light passed through a hole in the shutter becomes, in the contemplation of future men of science, the starting point in a great array of discoveries.

Professor Tyndall told us that the French physicist Malus, while one day walking through the garden of the Luxembourg Paris, observed a peculiar reflection of light from one of the windows of the palace; a closer study and examination of the phenomenon lead him to his discoveries respecting the polarization of light, which consisted in showing that light may acquire properties identical with either of two rays yielded, by refraction through Iceland spar, by the process of simple reflection at a particular angle from any transparent body. Thousands of people had seen the light reflected from a pane of glass in an identical manner, but no one had made any deductions from it. What good has grown out of these researches of polarized light? "What is the use?" In this this case, as in the preceding, the principle has been applied to many practical purposes. The value of glass for optical instruments, the extent to which glass has been annealed, the testing of stone jewels and the detection of paste diamonds, are accomplished by the use of a polarizing apparatus; but the most important application of the power of rotation possessed by different substances is seen in the apparatus employed to determine the quantity of sugar contained in any solution. The crude sugar of commerce is bought and sold on a polarized test, and millions of dollars are involved in the accurate use of discoveries which at first had no apparent value. The spectroscope and polariscope could not readily be dispensed with at the present moment.

While we are on this topic, it may be well to present a few more illustrations of the fact that nearly all great things are founded on what at one time appeared to be useless discoveries. Hans Christian Oersted observed the deflection of the needle produced by an electromagnet, and the needle telegraph was the natural growth of the observation; and afterwards, by further research, we arrived at the telegraph in its present form. A little deposit of copper on one of the poles of a battery when seen by De la Rive and Jacobi soon developes into electroplating and galvanoplastic operations. Gold, silver, copper, nickel and other metals, thrown down from solutions by battery currents, offer an occupation to a large number of persons, and enable publishers of illustrated papers to furnish their readers with prints for electrotype plates in a manner far superior to what was formerly accomplished in this line.

Professor Tyndall's observations on haze and dust have for their practical result improvements in ventilation and the discovery of the precautions to be observed to ensure good health.

Pasteur's researches on the germs of fermentation have revolutionized our former notions on this subject, and we recently published an account of the application of his theories to the brewing of beer and the conservation of wines. The same theory carried further in its consequences points out the probable origin of epidemic diseases, and thus indicates the best remedies to be applied.

Scarcely any body could have anticipated, in the study of minute germs, that out of it would grow methods for brewing beer or remedies to prevent contagion.

Faraday discovered, in the cylinders in which illuminating gas was formerly transported, a dirty, oily liquid, to which, subsequently, was given the name of benzole. Here was an instance where the utilitarian inquiry might have been made with great propriety: "What is the use?" Few discoveries have been more fruitful in their consequences than that of the detection of benzole among oil residues. Out of this body has sprung a long line of important industries. We have the most magnificent colors; we prepare sweet perfumes; we concentrate the light of illuminating gas; we dissolve resins and make varnish; and the investigations into the properties of this substance have conducted to the discovery of analogous compounds reaching far into the domain of organic chemistry.

Margraf found that an unsightly weed, growing wild on the shores of the Mediterranean, contained a small quantity of sugar and a large proportion of soda. By transplanting and careful culture, a large part of the soda was eliminated and potash substituted in its place, and the quantity of sugar considerably increased. The weed was transformed into the sugar beet, and an industry established which has proved to be of great value to the countries where beet root sugar is made. In the tubers of another weed, the fruit of which, in the form of bolls, is highly poisonous, was found large quantities of starch. It also was subjected to culture, and at the present time few articles of food are of more consequence than the potato. The detection of sugar and starch in vegetables was not regarded as of much account at the time it was made, and it was many years before any practical results grew out of it.

We can recollect when a peculiar gum called gutta percha was brought to the United States for the first time. It had been found by an intelligent traveler, and specimens of it were shown to scientific men everywhere, to see if they could make any practical use of it. It was a considerable while before its value was appreciated and the traveler was rewarded for his enterprise in bringing it into notice. We now know its immense value, for without it the submarine cable would be impossible, and the insulation of wires would be surrounded with great difficulties.

When Scheele discovered glycerin and Chevreul described its properties, there was no apparent use for it. It has now become one of the most important and useful products of chemical technology. A few years ago it was thrown away; now it is made in great quantities and the demand for it is largely on the increase. Nitro-glycerin, dynamite, lithofracteur, are among the secondary products of this interesting substance. The uses of glycerin in medicine, for the extraction of perfumes, in confectionery, to keep substances moist, as an antiseptic, are a few among the many uses for glycerin that could be stated.

These are some of the discoveries that passed through our minds while listening to the lectures of Professor Tyndall. The practical application of the subject is that no discovery is made in vain. As there is a conservation of forces, so is there also a conservation of discoveries. No force is lost any more than matter, and no discovery is lost in making up the chain that may lead to important results. Men who are engaged in what appear to be purely scientific pursuits, without the least practical bearing, are the ones who ought to receive more sympathy than they generally obtain. Their pursuits appear to be so useless to the common mind that they fail to receive due appreciation. It is safe to take for granted that every scientific discovery at the present time has its value. We may not appreciate it at the moment, but, as in the case of Newton's prismatic colors and Faraday's benzole, the time is sure to come when the world will profit by the discovery.

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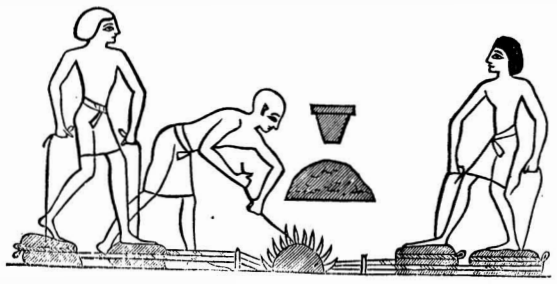
EARLY METALLURGY.

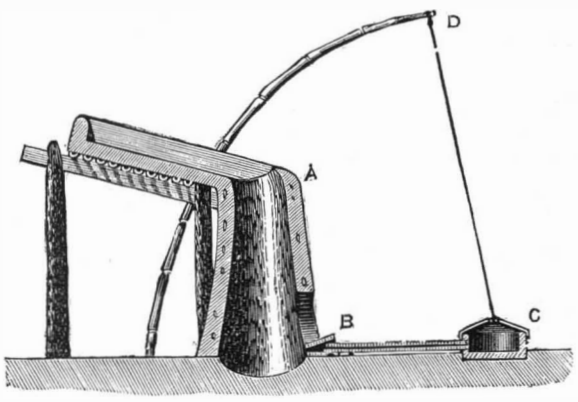
Iron was not in common use till long after the introduction of copper. It is far more difficult to procure, because it is not met with in the native state, and the fusing point is very high. The metallurgy of iron is more complex than that of copper, and when obtained, it is a more difficult metal to work. According to Xenophon, the melting of iron ore was first practiced by the Chalubes, a nation dwelling near the Black Sea, hence the name *chalups*, used for steel, and hence our word chalybeate, applied to a mineral water containing iron. Steel was known to the ancients, but we do not know by what means it was prepared; it was tempered by heating to redness, and plunging in cold water. According to some, *kuanos*, mentioned by Homer, was steel; but Mr. Gladstone prefers to conclude that it was bronze. Iron was known at least 1537 B. C. It was coined into money by the Lacedæmonians, and in the time of Lukourgos was in common use. It was used in the time of Homer for certain cutting instruments, such as woodmen's axes, and for plowshares. Its value is shown by the fact that Achilles proposed a ball of



Egyptian Bellows. Fifteenth Century B. C.

iron as a prize for the games in honor of Patroklos. Neither iron money nor iron implements of great antiquity have been found, because, unlike the other metals of which we have spoken above, iron rusts rapidly, and comparatively soon disappears. No remains of it have been found in Egypt, yet Herodotus tells us that iron instruments were used in building the pyramids; moreover, steel must have been employed to engrave the granite and other hard rocks, massive pillars of which are often found engraved most delicately from top to bottom with hieroglyphics. Again, the beautifully engraved Babylonian cylinders and Egyptian gems, frequently of cornelian and onyx, must have required steel tools of the finest temper. We have no record of the furnaces in which iron ore was smelted, but we know that bellows were in use in the fifteenth century B. C., in Egypt, and some crucibles of the same period are preserved in the Berlin Museum. They closely resemble the crucibles in use in the present day. The accompanying engraving represents a double pair of bellows, a furnace, fuel, and perhaps a crucible.

The native Indians prepare iron from hematite at the present time by equally primitive bellows, which indeed resemble the above very closely, and which, without doubt, have been unaltered for centuries. A small furnace, A (see accompanying section), is rapidly constructed of clay, and into the bottom of this, two nozzles, B, are introduced; these are connected with the bellows by bamboo tubes. The bellows, C, consist of cup shaped bowls of wood covered with goat



Smelting Furnace and Bellows used by native Indians in the present day.

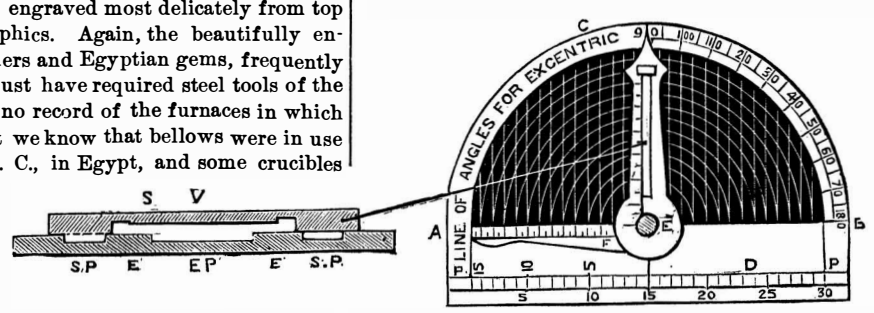
skin above, and connected with the bamboo below. In the center of the goat skin cover a round hole is cut; the blower places his heel upon this, which is thus closed, while, at the same time, the skin is depressed, and a blast is driven from the tube; then he steps upon the second skin, and thus a continual blast is kept up. The bent bamboo and string, D, is for the purpose of raising the goatskin cover of the bellows after depression, which, it will be noticed, is accomplished by the Egyptian bellows by a string raised by the hand. A piece of hematite is introduced with some charcoal, and after the lapse of some time, it is reduced by the carbonic oxide to a spongy mass of iron. Undoubtedly a crude furnace and appliance of this nature was used by the first melters of iron.

A New Way of Copying Drawings and Designs.

Some years ago it was proposed to copy black and white drawings by the employment of starch paper and the fumes of iodine. The process answered very well at the time, but has since been superseded by photography. We now hear of a new suggestion on the part of M. Rénault, who employs the reducing properties of hydrogen and phosphorus vapors. The drawing paper is first made transparent by washing it with a two per cent solution of paraffin in petroleum naphtha, and is then dipped in a solution of nitrate of silver. The design is written or printed with bromide or chloride of ammonium, and is then exposed to the action of hydrogen gas, or to nitrogen or carbonic acid which has previously passed through a tube containing fragments of phosphorus. The paper turns black excepting in such places as have been touched by the tracing ink. The design appears white on a dark background. If now a second sheet, similarly prepared with a silver solution, be placed beneath this and submitted to the hydrogen, the gas penetrates the white parts of the upper sheet and produces the design reversed upon the lower sheet. The author states that copper salts can be reduced in the same way. As these salts are much cheaper than silver, it will be preferable to use them. It is possible that, for copying labels to be attached to acid bottles, the method will prove available, particularly as the paraffin renders the paper unalterable by acids. For ordinary designs, it is a question whether tracings could not be more rapidly made through the translucent paraffined paper by hand than in the circuitous manner described above. It will be well for somebody to try the experiment and report the result.

GUIDE FOR SETTING SLIDE VALVES.

A B is a line of any length made to a scale to suit the convenience of the engineer. In this, one sixteenth of an inch means 1 inch. C is a line of angles; F is the crank graduated to suit diagram; E the eccentric, marked in inches as on the common rule. In the center of pointer runs a slot; in this must be placed a pin with a collar near its end, so that it can be screwed into a split nut; the hands are of brass, put together with an ordinary belt screw, a hole passing through its center to admit the pin. P P is a continuation of drop lines, the upper side being numbered from right to left, the under side from left to right, giving the full length of stroke of engine. To use it, first obtain correct duplicates of the valve, steam and exhaust ports, which lay off on a pair of thin laths; make the bottom of one fast and in line with A B, place the one representing the slide centrally over ports, arrange the hands as shown, at right angles; now move the pin in eccentric to the half required throw—in drawing 3½ inches;—screw the pin tight, slip on M the connecting rod,



and all is ready. Now move the excentric hand so that the slide just peeps past the crank hand back to dead center; this now gives angularity of eccentric. So says a correspondent of the *English Mechanic*. By moving round the pointers, the laths will show the condition of the engine under examination.

The Constellation of the Great Bear.

Miss Maria Mitchell, Professor of Astronomy at Vassar College, recently delivered in this city an entertaining and instructive lecture on the above topic, recounting the results of researches in the firmament, and sketching the progress of astronomy from the earliest knowledge to the latest discoveries.

After picturing the general view of the heavens, the lecturer stated that the Arabians were the first to study the science. The seven stars of the Great Bear have been spoken of from very ancient times. They are the seven sages of the Hindus, and are also called Charles' Wain and commonly the Dipper. They were named about 1,600 years ago after certain letters of the Greek alphabet. No two are alike in color, a fact that can be detected better by the unaided eye than with the telescope. A double star consists of two stars close together, usually of different tints and complementary in color. Miss Mitchell stated that she had often tried to match their hues with worsted, but had never succeeded; nothing resembles them except rubies and diamonds. A description was then given of her visit to the observatory in Rome into which she was at first refused entrance on account of her sex. Reverting to her theme, the lecturer alluded to Father Secchi as one of the earliest astronomical discoverers with the spectroscope. According to him, our sun belongs to the group of stars which give yellow light, such as *Arcturus* and others. She then spoke of the time required for the passage of light; a ray from the polar star reaches us 30 years after its emission. Some stars are variable, differing in splendor at various times, one in the Great Bear having its period of variation once in every 301 days. Our sun itself is a variable star. The solar spots have been noticed in great numbers during the past few years, but we do not perceive any difference in the quantity of light received from the sun's disk when it is thus obscured. Of late years, it has been noticed that the sun's spots have some connection with certain conditions of the planets.

WOMAN'S WORK IN ASTRONOMY.

In speaking of Sir William Herschel's labors in this field, Miss Mitchell said that he was assisted by his sister, Miss Caroline Herschel, who, night after night, patiently worked at recording what her brother saw. To do this work, she required a combination of qualities not often possessed by a woman.

But how was she appreciated? We are brought up to think not too highly of George III: let us, however, not judge him too harshly. When he heard of Caroline Herschel's labors, he gave her a position in the Royal Observatory, but when he found she was doing a man's labor, he gave her a woman's half pay.

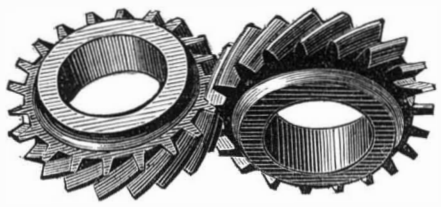
Mary Somerville became celebrated through her great translation of La Place's *Mècanique Cèleste*, a book which earned the highest praises from Sir John Herschel. The study of astronomy calls into play those perceptive faculties which women use in every day life in making their embroidery.

Miss Mitchell then alluded to the study of astronomy at Vassar College, where, she said, the sun was photographed every day and record of its changes thus kept. Movements of other heavenly bodies are carefully noted. The spectroscope shows that six of the stars of the Great Bear are moving towards the earth, while the seventh is receding.

Rays of light from some stars may take 100 or 1,000 years to reach us. They may have changed from white to pink or from yellow to red, while the record that the ray brings us is that of years ago.

GEARS FOR CHANGING DIRECTION OF MOTION.

Our engraving shows a form of gears for changing the

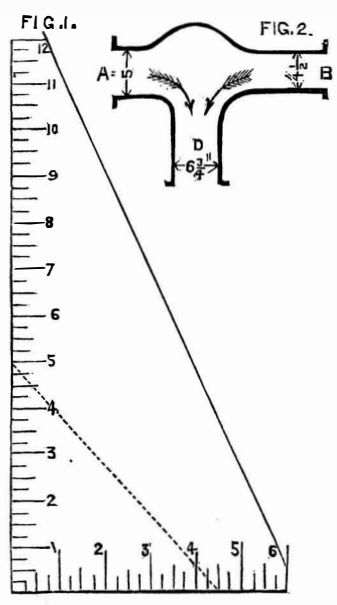


direction of motion, somewhat rare in use, but effective for many purposes.

THE PROPORTIONS OF PIPES.

We subjoin a sketch of a handy little contrivance, designed by Mr. George Cockburn, pattern maker, Glasgow, for ascertaining the diameter of a pipe, etc., having a sectional area equal to that of two other pipes, or *vice versâ*. The instrument consists simply of a piece of wood on cardboard, shaped like a set square, as shown in Fig. 1, or a diagram of the same form drawn on paper, and divided out along the two edges, which are at right angles to each other, the divisions being taken to represent inches, feet, or yards, etc., according to the kind of work for which the instrument is used. When employed for determining the equivalent diameters of pipes or bars, inch subdivisions will generally be found most convenient.

The mode of using the instrument will be readily understood from an example. Suppose, for instance, that two pipes, A and B, Fig. 2, respectively 5 inches and 4½ inches in diameter, deliver into a third pipe, D, and it be required to find the proper diameter for the latter pipe. Then from 5 on the scale of one of the divided edges to 4½ on the other,



draw a line, as shown dotted in Fig. 1, and the length of this line, measured with the same scale as that to which the edges are divided, will be the diameter of pipe required, in this case, 6¾ inches. On the other hand, if a pipe, D, 6¾ inches in diameter, be delivered into a pipe, A, 5 inches in diameter, and it was required to know what other size of pipe, B, could also be supplied, all that would be necessary would be to take the division point, 5, on one edge as a center, and, with 6¾ inches as a radius, describe an arc cutting the other divided edge. The point at which the latter edge was cut by this arc would show the diameter of pipe required.

Besides being useful for determining the diameters of pipes or circles of equivalent areas, the instrument is also available for determining the sides of equivalent squares, while, by a little contrivance, it can be made available for determining the diameter (or length on the side, if square) of a pipe or bar having a sectional area equal to the aggregate sectional areas of any number of other pipes or bars of which the diameters (or lengths on side, if square) are known. To use it for this purpose it is only necessary, first, to determine by its aid the diameter of pipe or bar equivalent to any two of the whole number, and next to ascertain the equivalent of the diameter thus ascertained, and that of a third pipe or bar, and so on. The arrangement of the instrument is, of course, founded on the fact that the areas of squares and circles increase as the squares of their sides and diameters respectively, and that the square of the hypothenuse of a right angled triangle is equal to the sum of the squares of its two other sides.—*Engineering.*

THRIFT.—Labor is the greatest promoter of happiness to individuals, of civilization and prosperity to nations. Steady work, with regular earnings, will do more for the elevation and comfort of the laboring man than any other effort that can be made in this direction.

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PROFESSOR TYNDALL'S FIFTH LECTURE IN NEW YORK----THE INVISIBLE RAYS.

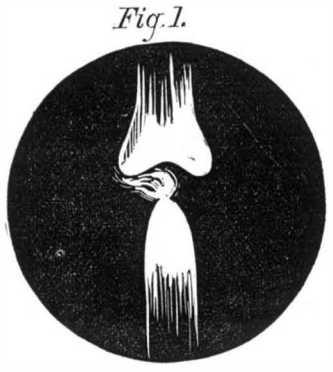
Is the eye capable of receiving visual impressions from all the rays emitted by the sun? The answer, said Professor Tyndall, is "No." On both sides of the spectrum there is a copious overflow of rays which are incompetent to excite vision, but which, however, are able to agitate the molecules of certain substances so as to shake them asunder and produce chemical decomposition. There are special substances upon which these ultra violet rays exert a special power. They darken the white salts of silver; and by permitting a spectrum to fall on paper properly saturated with a solution of such salts, the chemical action reveals the existence and the extent of the ultra violet spectrum.

RENDERING ACTINIC RAYS VISIBLE.

As a general rule, bodies either transmit light or they absorb it. There is a third case, however, in which light is neither absorbed nor reduced to darkness, but changed into light of another kind. Professor Stokes, in the University of Cambridge, has demonstrated this change of one kind of light with another, and has pushed his experiments so far as to render the invisible rays visible. A piece of paper, moistened with a solution of sulphate of quinine, was then introduced by the lecturer into the spectrum beyond the violet. Immediately a bluish tint appeared where previously none had been. The light from the electric lamp was then passed through a sheet of violet glass, and the experiment was repeated with the spectrum thus obtained. A sheet of paper properly prepared, on which a rose with leaves appeared in outline, was placed in this light, and immediately the rose assumed a delicate blue, and the leaves showed a tint of emerald green. These facts, continued Professor Tyndall, are due to the quality possessed by the sulphate of quinine, and other bodies, of changing the rapid vibrations of the rays beyond the violet into slower vibrations, and thus rendering the non-luminous rays luminous, and also changing one kind of light into another. Fluorescence is the name given to these effects. The human eye is a beautiful formation, as there is no doubt some substance in its crystalline lens analogous in its action to the sulphate of quinine.

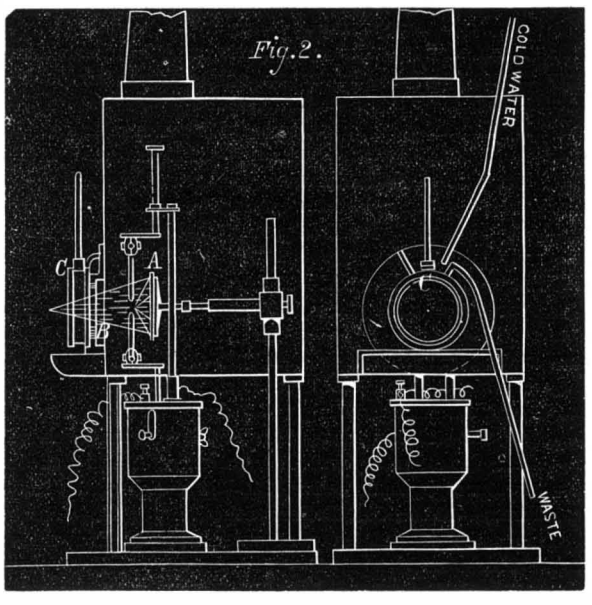
RENDERING HEAT RAYS VISIBLE.

Fig. 1.



The next question, said the lecturer, is: Is radiation capable of diffusing heat? Throwing the image of the carbon points on the screen, as in Fig. 1, he showed that ordinary

Fig. 2.

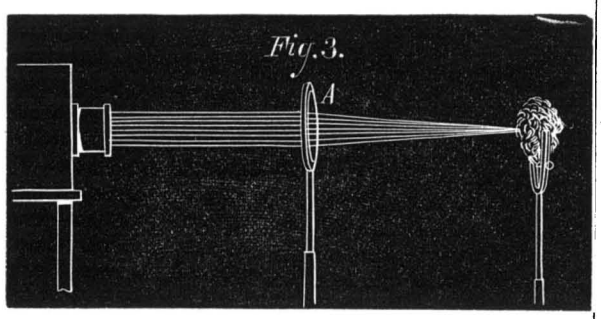


paper, saturated with gunpowder, could be readily ignited in the focus of the image. The rays were then caused to converge to a focus by the aid of a concave mirror in the apparatus shown in Fig. 2. A is the mirror from which the reflected cone of rays passes, first through a rock salt window, B, and afterwards through a solution of iodine in bisulphide of carbon, in C. Cold water is permitted to enter to keep down the temperature of the apparatus and prevent the vaporization of the bisulphide. So intense was the heat thus obtained that zinc and magnesium readily fused in the focus of the reflected rays.

HEAT CONCENTRATED BY A LENS OF ICE.

Professor Tyndall next went on to explain how the same effects may be produced by the concentration of the purely radiant heat of the carbon points by means of convex lenses. Even a lens of ice will answer the purpose. Arranging a piece of ice, ground in lenticular form, at A, Fig. 3, the lecturer ignited gun cotton placed in its focus. This mode of concentrating heat by an ice lens has never before been attempted with artificial light. The lens may be cold as the ice is, and yet transmit sufficient heat to ignite various substances. The fact is easily explained when we reflect that it is only those rays that are absorbed that produce the impression of heat. Professor Tyndall then ignited a diamond

Fig. 3.



suspended in a jar of oxygen by the heat radiated from the carbon points.

SEPARATING HEAT, LIGHT AND ACTINIC RAYS.

What constituent of the radiation produces these effects? By introducing a cell of alum so as to interfere with the light passing from the mirror to the focus, it was shown that the ignition of gunpowder in the latter position is prevented. If we bring the light to a focus by means of the mirror within the camera, and then cut off all light, certain effects which follow will give us a clue. Chemical combination exerts an enormous influence on luminiferous ether. The reason why we cannot see these rays is that the vibrations are too slow to awaken sensation on the retina. The atmosphere, which is a mechanical mixture of oxygen and nitrogen, is a practical vacuum to the passage of heat rays. When the atmosphere is dry, there is an enormous reduction of temperature, because of the amount of heat radiated by the earth into space. The elementary bodies, such as oxygen, hydrogen, chlorine, etc., are remarkably transparent to the rays of heat. Placing the iodine filter, C, (Fig. 2) so that the spectrum from the carbon points should pass through it, as the solution of iodine was weak, Professor Tyndall pointed out that only the green of the spectrum grew dim and disappeared. As iodine was added to the solution, the spectrum was more and more invaded and was finally cut off altogether, thus

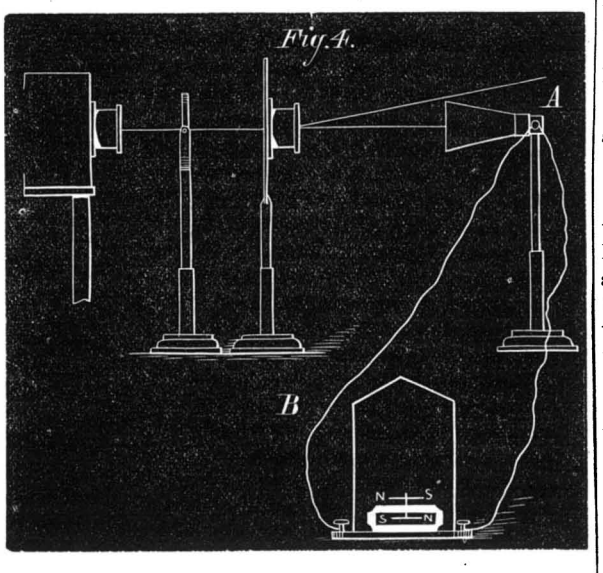
INTERCEPTING THE LUMINOUS RAYS

and leaving the calorific rays alone for examination. A piece of paper held in the point which was the focus of the light rays, although no traces of light were visible, instantly ignited. Professor Tyndall then inserted a plate of platinum coated with platinum black in the same position. Platinum, he explained, with its surface thus prepared acts in regard to the invisible heat rays just as the sulphate of quinine paper does to the invisible light rays. The temperature of the air surrounding the glowing platinum has nothing to do with this circumstance of heating. The air at the focus may be of a frosty temperature, as no heat is communicated to it from the mirror. The heat raises the platinum to a white heat without affecting the air. This is due to the fact that while the air cannot absorb the heat rays, the platinum can and does.

DELICATE DETERMINATION OF HEAT.

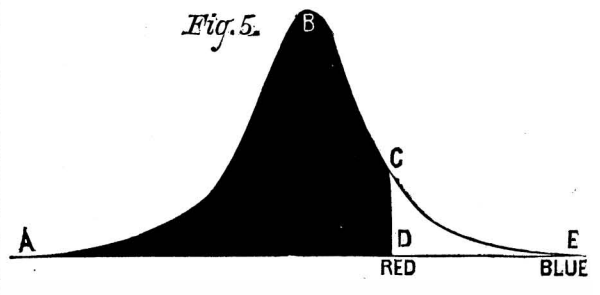
In 1821, Seebeck, of Berlin, discovered that heat applied to the junction of two metals of unequal heat-conducting power, soldered together at one end, the other extremities of the bars being connected with a galvanometer, would give rise to electric currents. This is the thermo-electric pile, which, arranged with a galvanometer, will indicate the most delicate differences of heat. In Fig. 4, A is the pile and B the galva-

Fig. 4.



nometer. With this instrument, we may discover the seat and intensity of the rays of heat in the spectrum. This is done by carrying the thermo-electric pile through the spectrum many successive times and noting its indications. The lecturer here referred to the diagram, Fig. 5, representing the

Fig. 5.



nvisible rays beyond the red end of the spectrum along with the visible rays in the curve of comparison. In it, the space A B C D represents the invisible, and C D E the visible radiation. By this and other modes of experiment it has been shown that the heat radiated from the non-luminous portion is seven or eight times as great as from the luminous or visible. We can now understand

WHY RED HEAT PRECEDES WHITE HEAT.

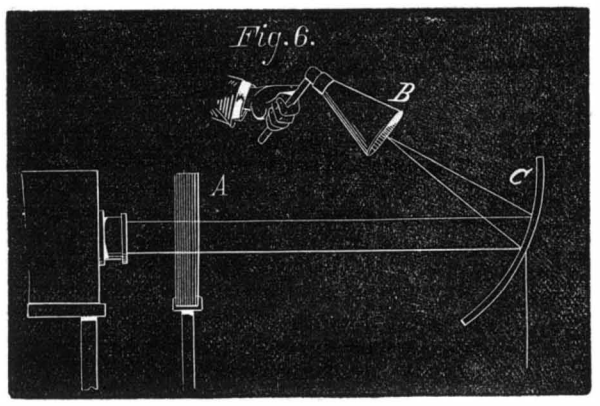
Dr. Draper has shown that the light emitted by glowing wire is first red, then orange, and so on through the other colors of the spectrum until, where the wire is white hot, all the hues are displayed.

At the beginning and even before the current acted on the wire, it emitted invisible rays. The vibrations or waves causing these were too slow to excite vision. They are not destroyed, but their intensities are augmented as the shorter waves are introduced. It is the wave amplitude and not the wave length which determines the intensity of heat as well as of light and sound. The rule is that the square of the maximum velocity of the wave determines its intensity. All these waves existed simultaneously. Without such, there could be no sun.

PART OF HEAT AND LIGHT RAYS IN NATURE.

The action of the sun on the tropical ocean results in warming the waters and vaporizing a portion for the production of rain and snow. It is the dark rays which accomplish these results. The light rays go deeper down. The non-luminous rays go but a short distance beneath the surface. Rivers are liberated by the same invisible ray. In order to show clearly that it is the dark and not the light rays that produce these effects, Professor Tyndall placed the thermopile, B, in the focus of a mirror, C, as shown in Fig. 6. An

Fig. 6.

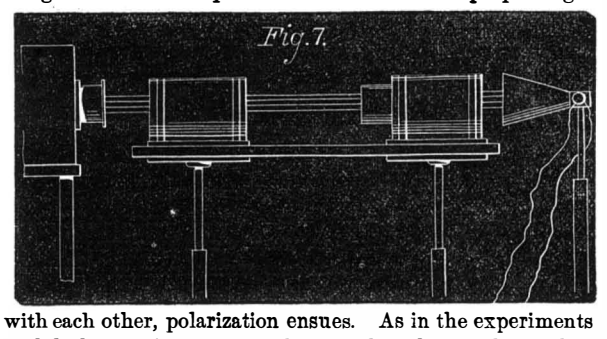


alum cell, A, cuts off the light, but the needle is found deflected though no light appears at the focus.

POLARIZATION OF HEAT.

By means of Nicol prisms and the thermopile, arranged as in Fig. 7, we may show that heat may be polarized as well as light. When the prisms are rotated to the proper angle

Fig. 7.



with each other, polarization ensues. As in the experiments with light, a pair of quartz plates with right and left polarizing power was then introduced, and in the deflection of the galvanometer needle there was shown the circular polarization of heat. Professor Tyndall stated, in conclusion, that it was by these means that the parallelism of light and radiant heat had been established.

John Ericsson.

A recent number of the *British Workman* contains an interesting biographical sketch, by Mary Howitt, of John Ericsson, of this city, of monitor fame. He was the son of a poor quarryman, and was born in 1803, at Wermland, Sweden. At a very early age he exhibited an unmistakable talent for mechanical construction. At the age of twenty-three, he had planned a hot air engine. In 1829, he was in England, and was one of the competitors in that remarkable trial of locomotive steam engines from which our present wonderful railway system has sprung. Ericsson's locomotive distanced all competitors, and for seven days he remained the undisputed victor, but on the eighth day the boiler burst and his iron nag, like any other broken down steed, lost the race. After this he planned a steam fire engine, and then a screw propeller, which, placed in a small vessel on the Thames, astonished all observers by its ability to tow great ships of many times its size. His efforts to induce the Admiralty and British merchants to adopt his screw failed, and in 1839 he settled in New York, where wealth and honors have attended him. Here he planned the first screw steamer for the American navy, the Princeton; and was engaged in many important mechanical works.

The fame of his latter days rests upon his successful planning of that form of ironclad known as the monitor vessel, in which the great broadside is done away with, and nearly every part of the ship placed below water save the small iron turrets which protect the guns. This form of vessel is now considered in England to be the strongest and best, and the heaviest ships of the British navy are at present built on that plan. In 1867, the people of his native village, in Sweden, erected a granite block in front of the humble cottage where he once lived, and upon it, in letters of gold, is this inscription:

HERE JOHN ERICSSON WAS BORN, 1803.

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Correspondence.

Sure Test of Death.

To the Editor of the Scientific American:

Dr. Mary J. Safford writes, under the above head, a note to the Boston *Transcript*, in which it is asserted, on the authority of Dr. Magnus of Germany, that "the surest test of death is to tie a string snugly around a finger or toe; if the subject be not dead, the member thus tied becomes red, and grows constantly deeper and darker colored, till it is tinged a blue red from the end to the point where it is ligated. Comparative experiments on the living body and on the cadaver have in every instance proved this satisfactorily."

Looking into the cause of this phenomena, it is evident that the red color is produced by the mechanical obstruction to the return of the venous blood; this explanation is acknowledged in the correspondence I have referred to, but it ought therefore to be also acknowledged that this is only a test for finding out if the circulation of the blood is still going on. It is true that, in every case where this circulation has not ceased, the red color described will be produced; but how about such cases of apparent death, in which the circulation has ceased, and the supposed corpse had grown cold? The red color would not be produced, and the poor victim would be pronounced dead and be buried.

The test in question is founded on the erroneous theory that in every case of apparent death the circulation of the blood has not ceased; therefore the comparative experiments on the living body and on the cadaver, which are undoubtedly correct, go for nothing. The cessation of respiration has, for an immediate consequence, the cessation of the heart's action; and if this condition continues long enough, all circulation will finally cease, and may be afterward followed by real death, from which the patient might be saved by proper means (such as artificial respiration, electricity, etc.). How long after the apparent death this real death, from which no return is possible, may take place is of course impossible to tell; it will vary according to circumstances; but I ardently wish that I had the means to inculcate into every person the principle of not having any one buried before the only sure sign of death has set in, namely, the commencement of putrefaction. This may be very soon observed in the region of the stomach, by a greenish discoloration; this is caused by the fact that putrefaction always commences in the abdomen; it may be seen at a comparatively early period, say 24 or 48 hours after the supposed death. I should be inclined to say then only that sure death has commenced; and when I think how many victims are hurried prematurely to their graves, without showing any such symptom and without any sufficient reason for the haste, I shudder.

It is more than 40 years ago that one of my nearest relations died unexpectedly; at that time I had not yet studied medicine; I believed implicitly in the declarations of the attending physicians, and had full confidence in the actual death. The burial of course took place as usual, but when afterward I recalled the symptoms of the disease and death, the appearance of the supposed corpse, etc., details which are still very vividly before my mind, and tested these with the medical knowledge later obtained by long study and practice, I have become more and more convinced that this was a decided case of apparent death, from which, with proper treatment, restoration would have been sure. I need not say that this thought has sometimes embittered moments of my life, and I write this with the sole purpose of saving others from similar experience.

P. H. VANDER WEYDE, M. D.,
Late Professor of Chemistry, New York Medical College.

Working and Doctoring Steel.

To the Editor of the Scientific American:

Some time ago, I wrote you concerning steel forgings and the hardening and tempering them by the use of salts, hydrates, etc., with especial reference to Mr. Siegfried's process. The article (in your volume XXVII., on page 277) was copied into the Newark *Courier* of October 26, 1872, and since then several persons have written and spoken to me, giving proofs of the truth of the assertions I made, namely, that poor steel could not be made into good steel by external working and doctoring. Let us see what constitutes poor and good steel. It is a question of the processes of production; and, to get at this properly, we must go back to the ore and its formation. But at present we will speak of forging. What shall we forge? First, let us see what our Government needs in the dock yards, arsenals, armories, navy and army. Poor steel is not wanted for any purpose, but, as a means of retrenchment and a low priced article, it is used, and, by Mr. So-and-so's process, it is said to be converted, while being forged from the bars, to a double refined quality, hard and durable. Let us look at this matter a little. If we will buy cheap steel, we must take puddled steel, or steel made from cheap and impure iron, bars rolled direct from the squeezers, or scrap iron melted in crucibles, carbon being added at the same time. This, no doubt, will be steel, poor and cheap. If cast into ingots, it may drawn; if not too impure or too highly carbonized, it may be washed; if it stands heating and drawing externally, the imperfections are remedied. Internally, no doubt, an ingot made of impure iron is of the same character; as old Tom Firth used to say, if you put the devil in the pot, he is there when the metal comes out. Most iron contains more or less zinc, phosphorus, sulphur, etc., which cannot be got rid of by melting. Mr. Bessemer in his process partially disposes of them, yet I find his steel very seamy. The longitudinal seams on the outside of the bars, which, in the molds, were globules, can be welded up with borax; but an application put on and cooled off will not do it; nor can carbon be subtracted from or added to the inner part of the ingot, except by remelting or baking, as is done with blistered steel. This latter is useless unless welded and closed together. If it were possible, and I wish it were, we could then convert all the old worn out railroad rais, of iron as well as steel, into new ones, made hard and durable; and machinery, light and strong, combining all necessary qualities for turning, boring, drilling, striking, engraving, etc., could all be made with tools forged from fag ends and broken railroad spikes. If Mr. Siegfried's, or any one else's, wash or bath can do this, or nearly so, it no doubt is valuable; if his wash or bath does not penetrate the inner part, but is confined to the outer surface, then old shoes, boots, and bones, with fire and water, have the control for the present. The other metals could not be obtained if it were not for steel, and iron, its base. It is strange that men, well informed in other respects, talk and write so much nonsense on this subject.

P. MCCORMICK.

Newark, N. J.

The Moon and the Tides.

To the Editor of the Scientific American:

For several years I have been of the opinion that tides are not in the least degree formed by attraction of the moon. Among the reasons for holding this opinion the following are enumerated: First, it is well substantiated that, at the Society Islands and many other parts of the Pacific ocean, tides rise to their greatest hight at twelve o'clock throughout the year. And as it is evident that those tides are formed without the moon's influence, it is but reasonable to conclude that other tides may be thus formed. Second, one of the daily flood tides, in the vicinity of New York, New London, etc., is at its greatest hight when the moon is on the opposite side of the earth; which circumstance shows that the said tides are not, in the very nature of things, caused by the moon. And it is argued that if one of the daily flood tides can be formed without the moon's influence, the other can be. Can not some of your correspondents "aerate" this subject, as an immense amount of time has been spent at the schools in learning a theory which I believe is founded in error?

S. S. G.

REMARKS BY THE EDITOR.—It is rather late in the day to call in question the influence of the moon on tides. If we see a locomotive drawing a train, we conclude that the moving power is in the steam engine. Astronomers and physicists have seen the waters of the earth drawn by some invisible attraction, and, after close watching and comparison of observations, have discovered that the force comes from the sun and moon. The periods of the tides are exactly those of the bodies which raise them. The semi-diurnal period of twelve hours and twenty-five minutes is comprised between the passage of the moon over the two opposite meridians of the earth. The diurnal period during which the ocean swells and subsides twice, corresponds exactly to the duration of one apparent rotation of the satellite around our planet. There is the same coincidence for the semi-monthly, fortnightly, semi-annual, and annual periods; in fact, every change in the relative position of the sun and moon towards our earth manifests itself by a corresponding change in the level of the seas. This coincidence is not accidental but stands in the relation of cause and effect. Knowing the route which the earth pursues through space, astronomers can anticipate the future oscillations of waves and map them for centuries to come, subject to local variations, due to heavy storms and changes in coast lines. The objection of our correspondent that the tides are highest opposite the moon proves the correctness of the above theory, for when we squeeze an orange it swells out at the ends and takes the form of an ellipse, and so does the earth; when the waters are drawn out at one end, the other sides wells in proportion. Read what La Place and Whewell have to say on this subject.

A Fire Escape.

To the Editor of the Scientific American:

In view of the great loss of life in recent conflagrations, I would suggest, as a means where there is no other chance of escape, that the person in danger should take a sheet, a piece of carpet, or its equivalent (something of the kind being always within reach) tie a knot in each corner, tie two corners round the waist from behind, and bring the other corners up over the head, grasping a knot in each hand; then extend the arms well forward as stiffly as possible and jump outward as far as he can from the building, where some person should hold an extended canvas, or its equivalent, to break the fall. If there should not be such persons, the jumper should extend the toes well down, and prepare to fold the legs under, as the shock would not be so great as if the legs were kept stiff. I think also that the person should spring from the house backward as the air would escape from the sheet in a way to take him or her further from the building.

This could be tried by some good swimmer without danger, as he could jump off some elevated position into the water.

Potosi, Mo. JAMES CURTIS.

The Proposed Great Telescope.

To the Editor of the Scientific American:

As you have suggested the construction, by the Government, of a telescope of much greater capacity than any now in existence, would it not be a commendable idea to suggest the circulation of petitions to Congress praying for an appropriation sufficient to construct the largest one that money and labor can procure? A work like this would do more for the cause of education and science than all the money that Government is now appropriating for scientific purposes. The law can be so guarded as to prevent any expense or outlay until the difficult portions of the instrument are completed.

A great nation ought to be able to undertake a great work. But in case my suggestion fails, then, in the columns of your valuable publication, open a subscription for the purpose of procuring the necessary amount. A few scientific gentlemen can arrange the details, and there can be no doubt but that the requisite sum will soon be secured.

Prominent scientific men, who are deeply interested in the matter, can deliver lectures upon astronomical subjects, and in this way procure the advancement of large amounts and at the same time create an interest in this most beautiful and comprehensive science. It is a subject well worthy of national consideration, and it is to be hoped that your journal will urge such action as will secure success.

THE TELESCOPE IN THE CAMBRIDGE UNIVERSITY.

About twelve months ago, the German Astronomical Society divided the northern heavens into zones of five degrees each, within which all stars up to the ninth magnitude are to be carefully observed twice and their exact positions recorded. Portions of this work were given to the observatories in Cambridge and Chicago, that of Cambridge being the zone included between 50° and 55°, containing about 7,500 stars. At the observatory of Cambridge, this work was begun on November 10, 1871, and it will require three years longer before it can be completed, only 700 stars having thus far been observed.

The telescope used for the purpose is a marvel of mechanical delicacy and ingenuity. It is nine feet in length, its object glass is eight inches in diameter, and it is constructed throughout of carefully beaten brass. At each side of the instrument is a system of prisms and reflectors, together with graduated circles divided into spaces of five degrees The figures on the latter are believed to be the finest in the world, four delicate microscopes being used in reading them. The prisms and reflectors are placed in glass cases, and serve to carry the light from a single flame to every point of the telescope where illumination is necessary. By this means, the small wires in the eye piece used for calculating the position of a star, and also the graduated circles from which the degrees are read by the microscopes, are brilliantly lit up; while another series of reflectors throws a flood of light over the recording table.

The best qualities of the telesccpe are its marvelous rapidity of movement and admirable steadiness and rigidity. By the aid of a finding arc, divided into spaces of five degrees, the instrument may be set eleven times in the brief space of one minute, at an equal number of degrees ranging from extreme north to extreme south. In zone work, where the graduated arc is necessarily much shorter, the telescope can be set even twenty-two times in a minute. The average work of the telescope is from thirty to thirty-five stars per hour. Fifty-two stars have been observed in this time, which, the Boston *Globe*, from which we obtain the above description, says is the most rapid work ever accomplished at the observatory. The shortest time in which the observation of a star can be made is thirty-five seconds. Between April 1871 and May 1872, four thousand observations were taken, and a catalogue of seven hundred stars made.

The Hartford Steam Boiler Inspection and Insurance Company.

The Hartford Steam Boiler Inspection and Insurance Company makes the following report of its inspections in the months of October and November, 1872:

During these months, there were 2,217 visits of inspection made, and 4,162 boilers examined—3,922 externally, and 1,311 internally—while 373 were tested by hydraulic pressure. The number of defects in all discovered were 1,981 of which 493 were regarded as particularly dangerous. These defects were as follows:

Furnaces out of shape, 102—23 dangerous; fractures, 202—89 dangerous; burned plates, 138—52 dangerous; blistered plates, 267—35 dangerous; sediment and deposit, 420—25 dangerous; incrustation and scale, 383—45 dangerous; external corrosion, 145—21 dangerous; internal corrosion, 55—7 dangerous; internal grooving, 22—3 dangerous; water gages defective, 123—19 dangerous; blow-out apparatus defective, 32—8 dangerous; safety valves overloaded, 59—29 dangerous; pressure gages defective, 235—33 dangerous. These varied from —10 to +20. Boilers without gages, 145—25 dangerous; cases of deficiency of water, 19—12 dangerous; broken braces and stays, 49—34 dangerous; boilers worn out and beyond repair, and condemned, 31. Many of the defects enumerated above come from neglect on the part of the boiler attendants. The boilers are blown down under heavy pressure, or, having been blown down, are filled up immediately with cold water, and bad fractures are caused. Some boilers have been found set with the minimum water line below the fire line. Theoretically, there is but one water line, and practically it should be the same; but we not unfrequently find water carried at different hights in the same boiler. The water gages or try cocks should be so arranged that water discharging from the lower one indicates a sufficient hight above the fire line to thoroughly protect the sheets from overheating. Boilers should be cleaned often. The accumulation of mud and various kinds of deposit renders the boiler liable to be badly burnt. There are many "little points" that must be observed, if safety and economy are to be attained. "Little things" neglected often lead to great disasters.

PROFESSOR TYNDALL sails for England on the 5th of February.

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GLEANINGS IN SCIENCE AND ART.

In Pursuit of Scientific Information.

Some years past, among a variety of presents to the Imaum of Yeman, from an Englishgentleman, was a medicine chest. His Royal Highness availed himself of an opportune visit of a European to his domains, to ascertain the exact virtue of each article, writing out in full with his own hand the dose, to prevent mistakes. How he succeeded in the administration of drugs to cure diseases of which he knew less than he did of the remedies has not been chronicled.

Before the dethronement of His Majesty the last king of Oude, in a collection of presents from the British Government was a box of soda powders. He demanded of the chamberlain of the palace what they were for? It was explained to him to be a right royal beverage, such as was habitually taken by the sovereign of Great Britain. "Well then," said the great potentate of India, "let me try them." One dozen papers of the soda were dissolved in a tumbler of water and gulped down at one long swallow. Smacking his lips, the monarch denounced it as a barbarous drink as ever was in vented, expressing unqualified surprise that Christian royal ty could revel on such horrid stuff.

Fortunately it was discovered that there were twelve papers of tartaric acid to go with the first. "Ah ha!" exclaimed the king, still scowling with the shocking taste of soda, "let us have them instantly." A moment after, the whole court was thrown into frightful alarm by the extraordinary contortions, writhings and groanings of His Majesty, rolling over the floor, oppressed with gas. He felt himself blown up like an air balloon, expecting momentarily to explode. When relieved, he expressed surprise that the civilization of Europe considered soda water a luxury for none but crowned heads!

Power of Intellect.

Thomas Telford, who died in London on September 2, 1834, was one of the most remarkable engineers of our times, when the circumstances of his origin are taken into consideration, as family influence is so potent in Great Britain. He was the son of a poor shepherd in Scotland. His father died when he was a small boy, leaving him alone to contend with poverty for position. Unaided he became a splendid French, Italian, and Latin scholar, and an engineer of such transcendant ability as to be an eminent authority. Bridge building was his *forte*. He built the suspension bridge at the Straits of Menai, quite as marvelous as the tubular bridge a mile above it. St. Katherine's docks in London are splendid evidences of Mr. Telford's extraordinary engineering attainments. His death was deplored as a national loss.

Androides.

Wandering one day through the streets of Vienna, notice of an exhibition of various mechanical figures was sufficiently attractive to induce us to enter. It was a rare collection of apparently self-moving men and women, who had everything but souls to make them independent citizens. Vaucarin was one of the extraordinary mechanical geniuses in the early part of the last century. His artificial duck, that paddled about the margin of a pond, picked up corn and significantly quacked at suitable intervals, was a wonderful triumph of skill, but the spinet player put into the shade every androidal invention before or since. There sat a really handsome young lady before the instrument (the forerunner of the present piano) with a music book before her. When wound up, the performer first looked either way upon the audience, bowed gracefully and then began to finger the keys. She swept her fingers to and fro the whole length of the instrument in the usual manner—the fingers acting separately—vibrating over the ivory so naturally as to deceive any one not informed that she was a mere machine made up of an aggregation of wheels, cams, levers and catgut cordage. As many different airs were executed as were satisfactory to an inquisitive stranger: of course old French music, in vogue when the artist finished the interior. After the springs were exhausted, the operator unbuttoned the musician's dress between her shoulders, unlaced her stays, and next with a key unlocked the chest. Swinging open a brass door, there was an exposition of contrivances, especially of cams as thin as paper sliding side by side, amazing to view. There was a multitudinous congregation of powers. Catgut cords extended from barrels down the arms to the extremity of each finger, which they controlled precisely like digital muscles. It would be a prolix story to dwell on all the *minutiæ* of that masterpiece. Suffice it to say that the man having the show, himself a mechanic of rare ingenuity, said that from boyhood he had read about the spinet player. When he had completed his apprenticeship, he went to Paris to find it. After a tedious persevering search, it was found packed away in a lumber room of one of the state departments, where it had been forgotten, having been there since the outbreak of the French revolution. He had permission to take it away on a promise to return it, he holding out an expectation of being able to put the lady once more in motion, which no modern artisan would undertake to do. He soon mastered the intricacies of the mechanism, and we saw it *redivivus*, good as new. Another androidal movement, quite as astonishing, in the same exhibition was a miniature old man, smoking while drawing a hand cart laden with trunks and boxes. Of course both man and cart were on a small scale, but so extraordinary was the resemblance to a live man bracing his feet in order to drag the load, a spectator could hardly restrain an expression of enthusiasm as the cart rolled along the floor. It was the production of a watchmaker somewhere in Switzerland, who was paid five hundred dollars for the curiosity, which he made in the course of long winter evenings. Since Menzel exhibited the mechanical chess player (which, by the way, was not conducted by machinery), although the rope dancer, a skilfully managed wonder, more nearly approached a first class androidal device, no very striking things have been invented of that kind, at home or abroad. The trumpeter was a marvel at first, but the same bellows would have supplied the instrument with wind if it had been in a barrel or a packing box. When that fact was realized by visitors, the excitement gradually subsided. Some inventors among us are capable of making such ingenious contrivances, but few can afford the time.

Primitive and Modern Light Houses.

Commercial enterprise must have the fostering care of government. Safety for life and property at sea is better secured remote from land than on the coast. Early, therefore, in the maritime industry of England, poor people residing near inlets, the estuaries of rivers, or dangerous rocks, were accustomed to build fires at night to apprise seamen approaching shore of their relation to channels, shoals, or ports, as the case might be, for which they received presents for their useful service. In time, such lights became indispensable. Finally, Government erected towers, supporting lanterns at the top. That took, from those who had kept watch fires, some of their living. Some were able to erect light houses themselves, and a law was enacted allowing them to collect, from passing vessels, a fee for the light. In the first case, ground rent was paid as a compensation for loss of their former pittance. Such was the beginning of light houses on the coast of England. At length a board of superintendents was created, to see that lights were attended to, which is the origin of the Trinity House. Even now, very many light houses are private property, yielding bountifully, and some of the old light house ground rents are extremely valuable, the foundation of the wealth of some families. They go to the custom houses to get their income, which the collector of a port exacts from coming and going vessels. American vessels for a long while were assessed for light money on entering English ports, while here, all light houses belong to Government, which never has exacted any thing from navigators. This condition of things, making us pay and paying nothing when English vessels came into United States ports, led to modifications of British light money regulations, so that no light house tax is now imposed on American vessels on arriving in British waters, as formerly. Instead of large blazing fires, as in the olden time, or till within a few years, consuming enormous quantities of sperm oil for light houses, it being the only kind that could be relied upon in extremely cold weather, the whole system has been improved immensely. The consumption of oil is far less, while many excellent arrangements of reflectors characterize modernly constructed lanterns. No new improvements have recently been suggested. France has taken the lead of other nations in light houses. A detailed description of the manner of utilizing light and throwing it to the greatest distance, as accomplished in France, would make an essay. Those who are particularly interested in that department of science would be profited by recent publications on the subject from the French press. According to an official report of the Light House Board to the present session of Congress, there are 179 sea and coast lights, 394 harbor and river lights, 22 light ships, 354 day (unlighted) beacons, and 2,762 buoys, in position at the expense of the United States. Besides, there are 33 air and steam engines, with signal trumpets loud enough to be heard above the roar of the surf, together with shrill whistles, the siren and other curious devices to give mariners seasonable notice in fog, storm or darkness. No nation on the globe is doing more for the interests of commerce and safe navigation than ours.

Diving Bell Deafness.

Considerable attention has been directed to well marked cases of deafness resulting from going down in a diving bell. One of these aquatic exploring machines is suspended from a crane in the Polytechnic Institution of London, and is usually let down in a deep tank every evening. Those desirous of ascertaining how it feels to be under water are permitted to descend Resulting from such excursions, it is alleged, the sense of hearing is impaired. More than eight years since a young lady felt a pain in her ears while under the bell. On coming to the surface, one ear was nearly deaf and the hearing in the other defective. The advice of an aurist proved of no avail. Diving bells are in constant requisition in harbor improvements. Large numbers of operatives are employed who are experienced in under-water work, but no serious injury to their ears has come to our knowledge. Possibly in a small diving bell, closely packed with visitors, the speedily vitiated air might derange the tension of the drum, which would drag out of place the little internal auditory bones; while in a very large one, no such contingencies are to be apprehended.

Raising Giants.

King Frederick William, of Prussia, father of Frederick the Great, determined to raise to order soldiers whose stature should meet his views of what grenadiers to serve royalty should be. The army was his hobby, and tall men his special admiration. He had a regiment at Potsdam that was the talk of the world, on account of their heads and shoulders being far above ordinary humanity. There were three battalions of 800 each, 2,400 in all, perfect Anaks, the shortest of the men being seven feet and the tallest nine. Such lofty beings were procured from all countries in Europe without regard to cost. James Kirkman, an Irish recruit, could not be had till six thousand dollars were paid. Tall men were decoyed and put into service at all hazards. Next he compelled them to marry unusually tall women, whether they consented or not. Prussia is rich in very tall subjects, the descendants of those gigantic grenadiers; these are far taller than the full blooded Kentuckians. In spite of his eccentric majesty's efforts, however, Nature would have her own way, and the children of such parentage were not all tall at maturity. Then again, another law came into operation to thwart the monarch's ambition to develop a race of monster men. Short men very generally prefer tall wives, and tall women, dapper little husbands. Of course there is no very philosophical way of accounting for taste, but such is the fact. There is a growth limitation to plants and animals. On reaching the predestined dimensions, those active artizans that built up the body, as far as the law of limitation requires, cease laboring and a permanent type of size is thus established. It is impossible to go counter to those laws and raise giants of any kind. A few individuals, transcending their kindred in altitude, are apparently accidental or at least are beyond explanation; but anomalies in that respect, like monstrosities, cannot be perpetuated through generations.

How Far we See.

Herschel was of the opinion that, with the telescope he used in those researches in the heavens which immortalized his name in the annals of Science, he could penetrate 497 times farther than Sirius, assumed to be at least so far distant that the sun is near at hand in comparison. While exploring with that instrument, 116,000 stars flitted by the object glass in one quarter of an hour, and that subtended an an angle of only 15°. So all the worlds are moving rapidly in space. Reckoning from the limited zone thus inspected, the whole celestial region could be examined by giving time enough to the enterprise; and judging from a few sections only within the scope of assisted vision, more than five billions of fixed stars might be reasonably supposed to be recognizable, and could be seen with modern improved instruments. But more are beyond, vastly beyond, and we are hoping and expecting that, when Mr. Clark, the self-made astronomer of Cambridge, Mass., and the most progressive telescope manufacturer now known to scientists, has completed his great work, far more amazing discoveries will be made in the firmament. Surely, the mechanism of the heavens demonstrates the existence of an Intelligent First Cause, since such magnificent displays of unnumbered worlds, regulated by laws which secure order in the universe, could not have originated themselves. God surely reigns and directs.

London Polytechnic Institution.

Instruction with amusement is the great feature here. All the lectures are of a popular cast, beautifully illustrated by men who have a faculty for making difficult things familiar to a child. It is a rare accomplishment. Most of the learned lecturers who come before the public shoot over the heads of the audience. It is a positive mistake to set in motion an artillery of unpronounceable terms, which only a Greek professor could comprehend. Lectures in that institution draw immensely, even in the middle of the day, so eager are those in pursuit of useful knowledge to hear and see. Chemistry has been a leading topic, though every branch of science has its representative in the course of the season. The fee is small, therefore the theater is full, and is crowded when a good lecturer is to appear. If precisely the same system were inaugurated in New York, and it could be kept from being the instrument of two or three professors whose reputation essentially depends on keeping all other talent out, the success of the enterprise cannot be doubted. One of the encouraging circumstances of the London Polytechnic is its perfectly democratic character. No one ambitious aspirant for fame is allowed to monopolize a chair to the exclusion of others. Thus variety in manner and matter is insured, and the public like it. An audience tires of the same lecturer forever and for aye—an arrangement sometimes called the American system. The stomach loathes to have only one kind of food at every meal. Variety is as necessary for the brain as a change of diet for the stomach.

Fat and Lean.

Meat eaters and vegetarians show in their persons the effects of the diet. The first has the most brain force and nervous energy. A mixed food of animal and vegetable rations developes the highest intellectual powers. A strictly vegetable living ordinarily gives a fair complexion, and amiability and extreme pugnacity when the vegetarian's views in regard to that one engrossing thought of his life are discussed. They are annual-meeting reformers, without ever setting a river on fire. Arabs are a sober, frugal race, rather slender, not tall, conscientious and contentious on religious subjects. They largely subsist on rice, pulse, milk and keimac, something similar to whipped cream, through a vast region of an arid country where they are indigenous. They are not destitute of mutton, goats, camels and game; but they manifest no disposition to feed upon meats, as is necessary in temperate zones or in high northern latitudes. An intellectual man, one of their kindred, who rises to distinction by the grandeur of his mental status, is extremely rare. The beer and ale drinkers expand and grow fat, but they are not much given to profound researches in Science.

Death of Professor Rankine.

We regret to hear of the death of W. J. M. Rankine, Regius Professor of Civil Engineering and Mechanics in the University of Glasgow, Scotland. The deceased professor had a long and widely extended reputation, and was a member of many scientific societies in the different countries of Europe and America. His "Manual of Machinery and Millwork" is a standard authority on the geometry, dynamics, and construction of machinery. He died at Glasgow on December 24, in the 53rd year of his age.

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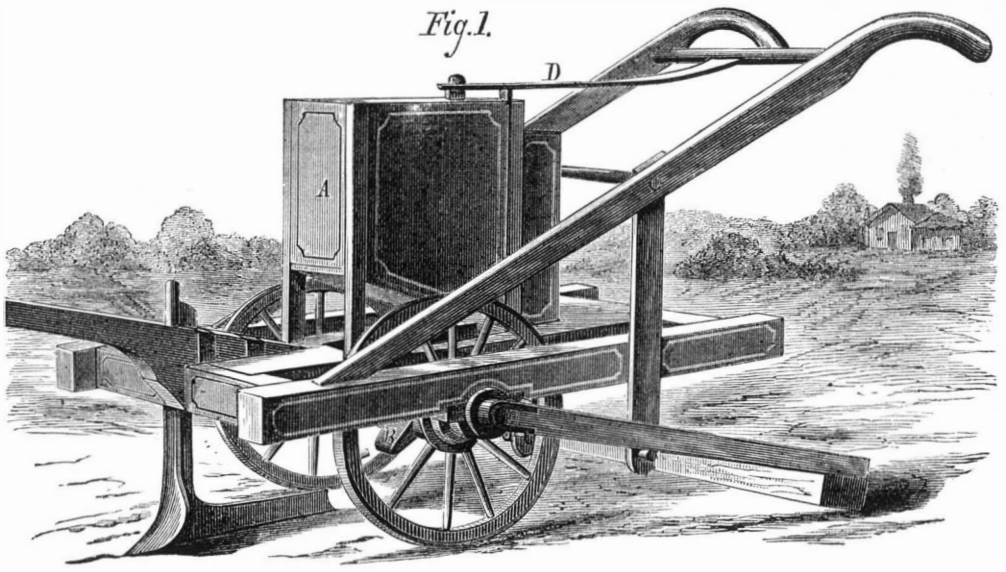
IMPROVED SEED PLANTER.

The invention herewith illustrated is a seed planter in which the amount of seed required for a hill is elevated within the seed hopper, and discharged through a hole in the upper part of the hopper into a drop tube. The seed is thus deposited at proper intervals and without injury.

Fig. 1 affords a perspective general view of the device, and Fig. 2 a sectional plan from which the working details will best be understood. A is the seed hopper mounted on a frame supported upon wheels. The axle revolves with the wheels, and upon it are cams, B B, which impinge upon the lower end of a slide, C. The latter is thereby caused to reciprocate, being first raised by the cams and then returned to its original position by the reaction of the spring, D, attached to its upper extremity. The slide, C, moving close to the back of the hopper, carries a cup, E, shaped as shown. In the back of the hopper is also the opening, F. When the slide, C, is raised by the cams the cup is brought opposite this aperture, through which its contents pass into the discharge tube, G. The orifice, F, is kept closed while the slide is down, by means of a spring cover, H, which is raised clear of the hole by the ascending cup. The partition, I, in the hopper is notched or perforated at the bottom to regulate the hight to which the seed fills the back compartment. When it is desired to transport the planter from one locality to another, the slide, C,, is held elevated clear of the cams by means of the bolt or catch, J, on top of the hopper. The furrow for receiving the seed is opened and closed by suitable devices attached to the frame of the apparatus.

Fig. 1.



DANCY'S SEED PLANTER.

Patented through the Scientific American Patent Agency, October 29, 1872. For further information relative to sale of rights, etc., address the inventor, Mr. John H. Dancy, Dancyville, Haywood Co., Tenn.

COOLING OUR HOUSES.

To the Editor of the Scientific American:

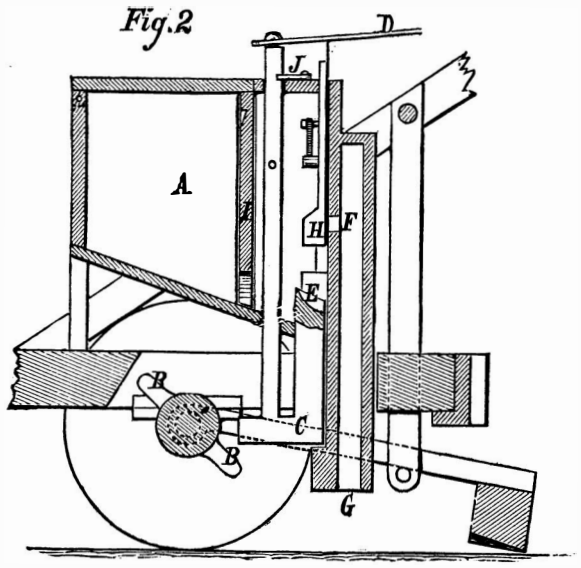
In your paper of September 4 was published an article of mine on heating and cooling our dwellings, to which replies were made in the issues of October 5 and 14, on which I desire to say a few words.

In the article of October 5, R. H. A. expresses the idea that my method might prove injurious, as there is danger in a sudden and extreme lowering of the temperature from 90° to 75°, the dew point. Of course there would be danger if it were carried to an excess, as there is in all excesses; but of this there is no probability whatever. During the past three or four years, the experiment has been thoroughly tried in the Capitol building, in this city, and instead of making it dangerously cool, the only difficulty has been to get it cool enough. As is generally known, the building is ventilated by means of fans worked by steam engines located in the basement, which force a large volume of air, through passages, into the rooms above, the air being heated during cold weather by means of steam pipes laid in these passages. During the summer session the halls were uncomfortably hot: and, to remedy this, large quantities of ice—a tun or more at a time—was placed in the passages, and the air passed over and through it, but with little effect. It was found impossible to lower the temperature in the House or Senate more than from 2° to 4°. Finally, the present engineer of the Senate, Mr. H. F. Hayden, hit upon the plan of water spray in the air chamber: a fine spray or mist, as though made by a gigantic atomizer, and the result was most beneficial, the temperature being reduced from 10° to 14°. This has now been used for two seasons or more, without any injury.

I give you herewith a diagram of the building, showing the apparatus in operation. So I think R. H. A. may dismiss his fears on that point. It is not so easy to lower the temperature of our rooms in hot weather as to create any danger from an excess in that direction, as those who try it will find.

With reference to the plan suggested by Egberd, in the issue of October 14, I would say that it is not practicable, especially in cities. As a general rule, there is no room for building the tall chimneys and digging the connecting tunnels suggested by him. Besides, such an arrangement would cost more than an ordinary dwelling, and is, therefore, out of the question in private residences. And unless the air in the building was at a higher temperature than that outside, the current would be from the house out through his chimney, the heated outer air, of course, rushing into the rooms through the windows and other openings, and thus creating the same temperature in doors as out. Even if an inward current could be assured, the air would not be perceptibly cooled by passing through his tunnel, unless of much greater length than would, in most cases, be found possible to make. A tunnel without the chimney, I believe, is in use at the Government Insane Asylum, just over the Potomac river from this city, and is found to work well; but it is both long and large, there being plenty of room, and the ground is well adapted for such a purpose.

Fig. 2

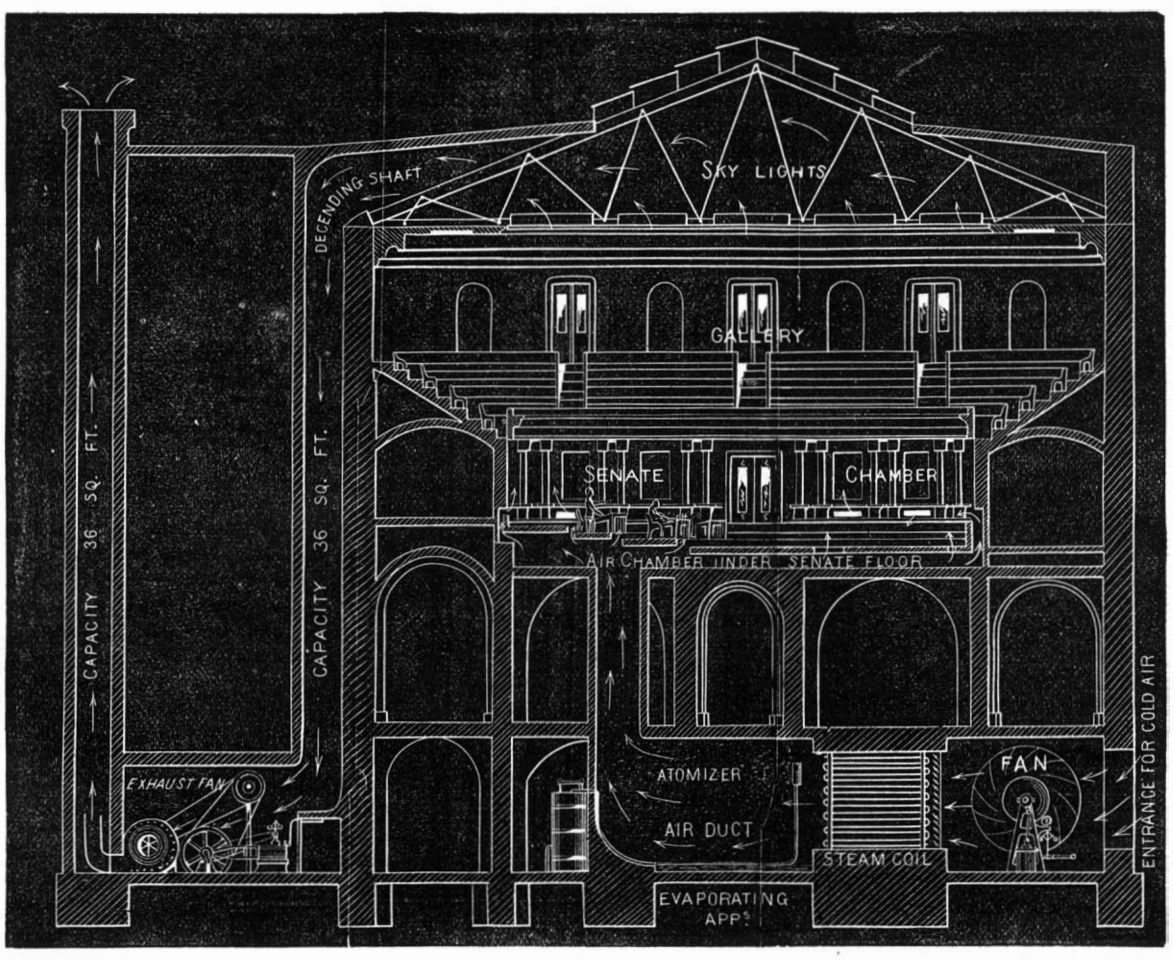


Some other correspondent, I forget who, suggested as an improvement that the apparatus should be located in the attic instead of the basement, for the reason that the cold air, being heavier, would naturally sink, and thus require less power. That is true; but unless the air in the attic is first cooled it would not be heavier; and it is impracticable to locate and operate the cooling and forcing apparatus in the top of the house. Power must be used, and to render it convenient, it must be down stairs. As yet, I have seen nothing to convince me of the impracticability or danger of my plan, previously described, and I intend to give it a thorough trial the coming summer.

In conclusion I may state that, during the heated term of the past summer, I had located over my desk a fan, operated by a small water engine of seven eighths inch piston, and I found it such a luxury that I intend never to be without it hereafter during hot weather, in this latitude at least.

W. C. DODGE.

Washington, D. C.



ELEVATION SHOWING THE DEVICES NOW IN USE FOR WARMING AND VENTILATING THE SENATE CHAMBER WASHINGTON, D. C.

Exhalation of Carbonic Acid by Man.

Some interesting researches on the quantity of carbonic acid exhaled in a given time from the skin of a man have been conducted by Herr H. Aubert and his assistant, Herr Lange, and have appeared in the last number of Pfluger's *Archiv für Physiologie.* The experiments have been carefully made in an air-tight chamber, in which the subject for experiment was seated, and through which a current of air, freed from carbonic acid, was steadily passing, while the proportion of carbonic acid in the air on leaving the chamber was estimated by transmission through bulbed tubes containing a solution of a salt of barium. The results of these investigations lead to the general conclusion that sixty-two grains of carbonic acid are exhaled from the body of a full-grown man, through the skin, in the course of twenty-four hours.

The "Scientific American" in Philadelphia.

Messrs. Richards, London, and Kelley, of Philadelphia, Pa., write as follows: "We have presented, to each of some 8 or 10 apprentices, a subscription to the SCIENTIFIC AMERICAN, believing that they will be much the better for reading it. They are pleased with the idea and are stimulated to increased interest in their trade. Many of our workmen have been subscribers for a long time, so that fully 50 per cent of them are taking your paper, as well as other mechanical works—a reading community. We will add to the list of subscribers as we have occasion. Permit me to add that the SCIENCE RECORD is very finely edited and is very interesting. It will receive a position in our library."

Gentle Words for Horses.

If horses were next thing to deaf, there would be an excuse for the shoutings and yellings so generally indulged in, but they are not, and therefore need not be spoken to so loudly and harshly. The ear of a horse is very sensitive, and, save in exceptional cases, it is possible to control his motions by a command given in a moderate tone of voice.

A horse is a teachable animal, and is always affected by kind treatment The fact of the matter is that, if kind words and gentle treatment throughout were given to these noble animals instead of oaths, curses, and blows, we should find their docility greatly increased. Just imagine, if you will, a gee! or whoa! uttered in a tone sufficiently loud to be heard half a mile distant, and this command given to an animal within five or ten feet of the party giving it. Wherein consists the necessity for it? Why not resort to more rational and certainly more pleasing means? Why not speak in a moderate tone? This is all that is required. The horse, if not deaf, can hear it, and will as readily obey as if given in thundering tones.

One of the best managed teams ever seen was controlled by the driver without the indulgence of this unmusical yelling. The driver rarely ever spoke above his ordinary tone of voice, and yet his horses laid into their work with as much willingness and apparently greater earnestness than if they had been driven to it by fearful shoutings and blows. The horse is an intelligent animal. None of the brute creation more readily appreciate kind words and kind treatment. Such facts should be considered always by those who have the care of these animals.

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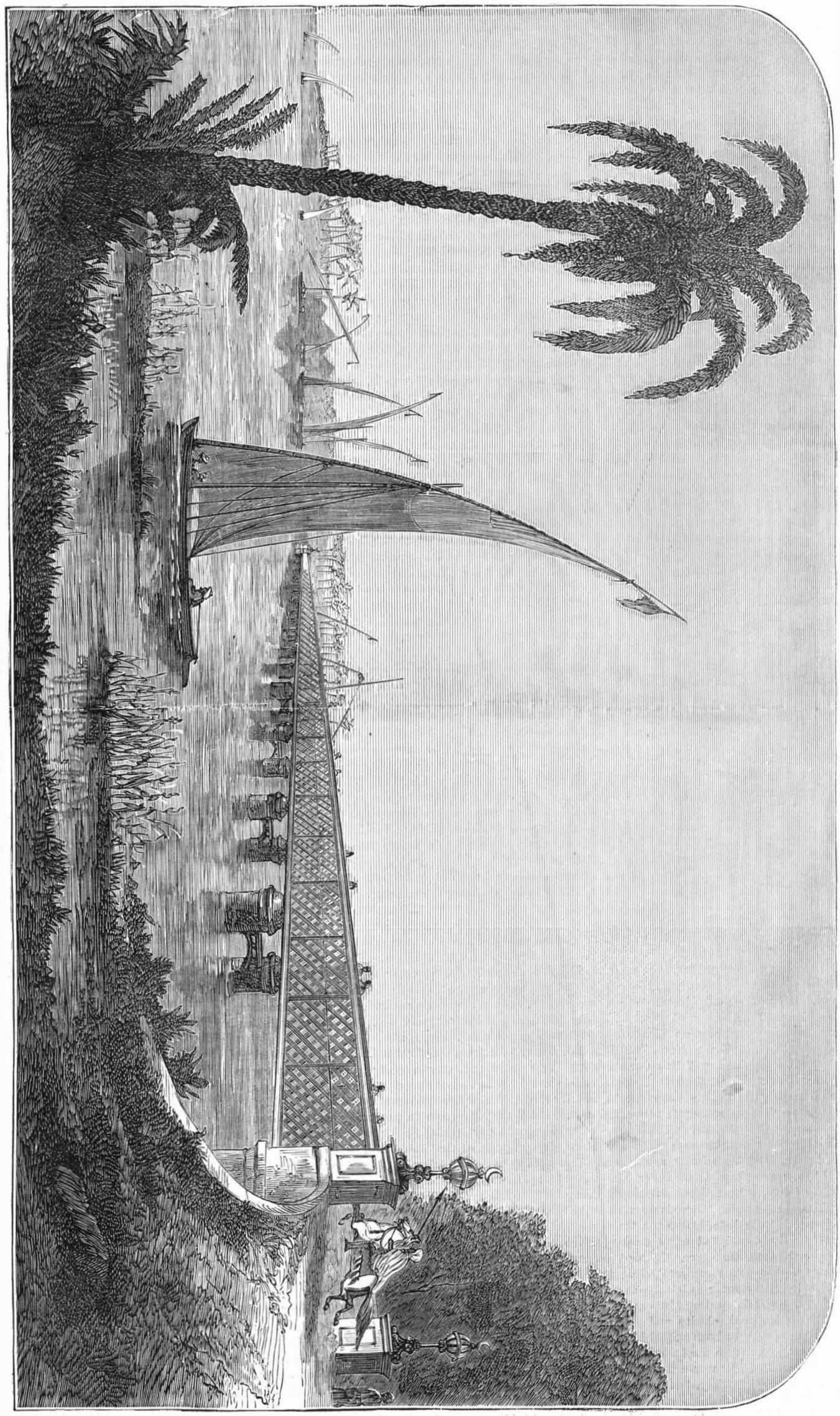
NEW BRIDGE OVER THE NILE.

The accompanying engraving, prepared from a sketch made on the spot for *The Engineer*, shows a handsome new bridge across the Nile, which has just been completed for the Egyptian Government by Messrs. Shaw and Thomson, of Leadenhall street, and their colleague, Mr. John Dixon, engineer and contractor, of Laurence Pountney Hill, London.

In furtherance of the vast improvements which the enlightened policy of the present ruler of Egypt, his Highness Ismail Pacha, has inaugurated, it had become absolutely necessary to connect the city of Cairo with the fertile and populous district on the opposite banks of the Nile, a district lying between the river and the Pyramids, embracing the town of Ghizeh itself, innumerable villages, large and small, the palaces of the Viceroy at Ghizeh and Ghizereh, and those of some of his principal nobles.



BRIDGE OVER THE NILE AT GHIZEH.

Some two hundred years ago the erratic and invading Nile flowed past Cairo in one grand unbroken stream. The accidental sinking of a native felucca or barge, laden with stones, caused the formation of a sand bank. This sand bank, silting up, gradually increased in size, and in time became dignified by the name of the Island of Ghizereh, which is now some four or five miles long and more than a mile broad. Down each side of this island flowed an arm of the noble river. On the shore opposite the suburban palace of Kasir-el-Nil stands that of Ghizereh, best known to European visitors by the gorgeous festivities celebrated there on the occasion of the marriage of the eldest daughter of the Khedive, or what in England they would style the Crown Princess of Egypt. Close to this spot a bridge of boats was, for some years, in existence to accommodate the teeming traffic, which floating structure gave place, early in the present year, to the permanent bridge of Kaser-el-Nil, constructed by a French company and French engineers during three years of labor.

Meantime the western arm of the river had been rendered passable by the thoroughly Egyptian expedient of throwing dams across it, on the tops of which the roads were formed. But old Nilus would not tolerate such restraint, and, threatening to burst his bonds and widen his bed, by washing down the palaces and quay walls that bordered his sole remaining channel, it became imperatively necessary to bridge over as rapidly as possible and reopen the old waterway.

Time being an object, the work was confided to English hands, and with a result that seems fully to have justified the confidence thus reposed. The plans, designs, and arrangements were, we believe, matured by Mr. Dixon, the engineer, and submitted to the approval of Mr. Fowler, as chief consulting engineer to his Highness the Viceroy. An active commencement with the works was made in the beginning of January of the present year. By June, sixteen cast iron cylinders, 88 feet long and 8 feet 6 inches in diameter, had been sunk in the bed of the river, and six smaller cylinders had been fixed. By September, 1,700 tuns of iron work had been manufactured and sent out from England, transshipped up the Nile, and placed in position; the masonry and concrete were completed, the swing space was turned round on its axis by the aid of one man, and in November the finished structure was finally handed over to the intelligent young Prince who presides as chief of the Public Works Department in Egypt.

The bridge belongs to the class of works which benefit a country. The work belongs to the industrial monuments by which Ismail Pacha will be best remembered. The bridge is of iron double trellis girders, and constructed with a swinging draw having a one hundred foot opening. The length of the bridge is 1,350 feet; width, between centers of girders, 40 feet. Total weight of the iron work, 1,700 tuns.

How Dangerous Ice Gorges may be Avoided.

A correspondent of the St. Louis *Railway Register* furnishes some timely hints relative to the removal of the ice gorges which, forming every winter in our rivers, often cause great damage to vessels and other structures. These gorges are sometimes isolated, but sometimes a succession of them, separated by intervals of but a few miles or less, is formed: they are occasionally of such magnitude and depth as to completely dam up the river, especially if resting upon a hard bottom, producing inundation of the low lands. There is generally sufficient head in the confined water to cause the ice to move with considerable velocity upon the sudden rupture of the gorge.

Ice can be blasted as well as any other material, and ice blasting has been frequently practiced in Europe. For this purpose any of the explosives can be used; blasting powder is employed where slow burning is required, and for quick burning any of the explosive compounds, as dualin or dynamite, will serve. In breaking up a gorge, one would commence in general at the lower end, taking off strips all the way across, allowing them to float down with the current, and working up thus towards the head until the end was accomplished. Care would be required not to produce enough disturbance to start the whole mass at once, as, in that case, the operator would produce just what he was aiming to avoid, and perhaps bring down a mass of ice on himself from some point above. Where it is necessary to remove an intermediate gorge, and there is not current enough in the reach of water below it to float off the pieces, a moderate current could be induced, in some cases, by opening a narrow cut in the gorge below, although this might be an operation of some difficulty. Where a line of telegraph runs in close proximity to the river, several parties can operate simultaneously and in concert, by means of the rapid and easy communication thus afforded. Of course it is not assumed that circumstances will always favor blasting, but that it is sometimes of great benefit, experience in other countries has plainly shown.

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LEARN TO DRAW.

To the artisan, there is no acquirement outside his trade which is of more direct benefit than a fair knowledge of drawing. The mechanic that can make a graphic sketch of a machine or a good working draft of the same possesses an advantage over his fellows that will materially promote his advancement and, besides, greatly facilitate his education in his chosen calling.

Drawing, like instrumental music, requires the cultivation of both eye and hand; the former to appreciate things as they really are, in form, color and position; the latter to act as the servant which reproduces the similitude of the objects recognized by the perceptive faculties. It is, therefore, necessary to bring both mental and physical powers to a given degree of education in order to attain a certain amount of skill.

A few practical hints on this subject, designed to serve as an answer to the question "How shall I learn to draw," will perhaps be found of advantage. At the beginning of the study, exercise the eye in appreciating the shapes of simple objects and the memory in retaining the notion of form. We must learn, and no principle must be more strictly followed, to see a thing as it appears, not as reason tells us that it is. For a common example, we well know that a certain piece of furniture, a table, is of such and such a shape; that is, its legs are of equal length, that they rest on the floor, its top is flat, etc. Now, if we wished to depict our table in a sketch from a given point of view, if we allowed our knowledge to govern our eyesight, we should undoubtedly fail to produce a correct representation; and this simply because, relying upon fact previously acquired, we should draw what we do not see. We should, to exemplify, make all four legs of equal dimensions, whereas those furthest from us appear the shortest; we should represent the flat surface as rectangular instead of oblique and acute angled, and, to carry out the idea still further, did we color our drawing, we should paint it a single shade of oak or mahogany, so that in the end we should have a distorted image of a uniform hue. We should thus annihilate distance, light and shade; and to illustrate once more our mistaken method, we would represent two similar objects, one beside us and the other half a mile away, as of precisely the same dimensions. Without pursuing this branch of our subject further, let the reader either try the effect for himself, or, if he desires a more graphic representation, let him look among Hogarth's engravings, to be found in book form in any public library, for a landscape which he will find thus depicted. The absurdity of the drawing is obvious.

Necessarily, the rules of perspective will aid us to avoid the above difficulty; but, except for mathematical drafting, we should advise the student not to hamper his mind in the beginning with geometrical demonstrations, but to educate his eye to unassisted effort. Nature is the best teacher, and constant practice in representing her in her ever varying forms will lay a better groundwork for future accurate drawing than all the treatises ever compiled. Let us counsel the beginner at the outset to beware of published systems or "drawing without a master" handbooks; we never knew them to produce any other result than an inextricable confusion of ideas. The student should commence with pencil and paper to depict the simplest object—for instance, a box—and represent it in all positions. It may at first be difficult to perceive the exact form, owing to the relief caused by light and shade; but if the eyes be partially closed and the object regarded through the eyelashes, it will appear to be an irregularly shaped mass and its outline will be readily followed. No matter how rough first attempts may be, persevere. Skill can only be acquired by practice; and as the perception is educated, the hand will grow in cunning. Avoid artificial aids of every kind; they only retard true progress. Erase as little as possible; aim at correctness at once; do not make a line until it has been considered. Work slowly—rapidity of execution and brilliancy of effect will come in proper season. Study to express an idea in as few lines as possible. A glance at the works of skillful artists will show how simply and yet how surely every stroke of the pencil has a definite purpose. Follow Ruskin's advice, and never give away a drawing; to present a friend with a poor one is no compliment; to donate a good one is to deprive oneself of the best result of all previous labors. Keep all, failures and successes; they are milestones in our onward path. Systematically avoid the lithographed pictures sold to serve as copies; we never saw any that were not, at best, of doubtful excellence, calculated to rather mislead than advance the pupil. There is no merit in servile copying; if such is to be done, better use tracing paper at once. Draw boldly—timid and weak strokes never produce broad effect or a vigorous picture. Better see too little than too much—a few curves accurately drawn represent a tree in a sketch infinitely truer to nature than the labored and necessarily imperfect delineation of every leaf or spray. Facility in outlining acquired, shades and shadows may be studied. Here the counsel of one skilled in art may be sought. We mean skilled in art in the fullest sense of the term; a poor or mediocre teacher is worse than none; the best talent attainable may be more costly, but it proves the cheapest in the end. It is an abominable practice in many schools to have the students' drawings "corrected" by the master. It is needless to add that every spark of individuality is extracted from them, in order that the pupil may "show progress," or, by producing pretty pictures, gain a fraudulent credit for the instructor. This, of course, should not be permitted, for the teacher should be but a guide to call the attention of the learner to what would otherwise escape his notice; to point out that certain effects that apparently are the result of accident, are subject to known laws, and finally to instruct in the mechanical labor of the manipulation of materials.

It is excellent practice, after a fair degree of skill is acquired, to strive to produce representations of images formed in the "mind's eye." Houdin, the French conjurer, says in his memoirs that his marvelous dexterity in deceiving the senses of others was largely due to the high cultivation of his perceptive powers. He mentions that he began by rapidly walking past a shop window and afterwards trying to call to mind as many of the objects therein, together with their peculiarities of form and color, as possible, afterwards verifying his memory. This plan on a simpler scale may be practiced in learning to originate. Commencing as before with some simple article, regard it carefully, and, after placing it out of sight, endeavor to draw it from the image left in the mind. From this, advance by degrees until it is found that a short glance at an object is sufficient to ensure a fair representation of its general appearance. Then seek to imagine forms and to draw them correctly, always remembering to select such articles as subjects as that the sketch may be verified with the original after completion. Do not aim at too high a standard; it is well to recollect that art is a jealous mistress and requires long years of servitude before she becomes the servant of her pursuer. Seek rather to obtain a fair proficiency, when further progress will be optional and dependent solely upon the ability and desire of the student to devote the necessary time and labor.

In conclusion, let us add a word as to how working men may learn to draw. It is better for some one man to seek to interest his comrades and so get a number together in pursuit of the same object. The enthusiasm of a single individual is apt to fall when unsupported; competition between several is an excellent incentive to labor and success. We were recently informed of an admirable plan adopted by the mechanics in the shop of the New York Steam Engine Company, in Passaic, New Jersey. These men have clubbed together, purchased for a small sum the necessary instruments, and are now pursuing, during their spare time, a course of mechanical drafting under the guidance of the draftsman of the establishment. This example deserves to be widely followed, and we believe that these mechanics will have no cause to regret so wise an expenditure of unoccupied hours. The same system may be adopted by a sketching or reading club, and thus every opportunity gained for mutual and self improvement.

The inventor that can represent his idea upon paper, and thus give it tangible form, is at once possessed of an object capable of elaboration. His mind is unburdened, as it were, and free to range to other thoughts. The artisan that can fill a volume with suggestions of improved devices as they occur to him in the routine of his every day life, or is able, sketch book in hand, to jot down the good ideas of others, secures an unfailing fund of information, which, if not some time directly productive of lucrative returns, will be of inestimable benefit to him throughout his whole career.

DR. DRAPER'S RESEARCHES IN ACTINO-CHEMISTRY.

The well worn figure, which likens the investigator of the secret laws of the universe to the explorer of unknown lands, is truer than we sometimes think it; and the history of the outposts which he thrusts far into the dim region of the unknown is very apt to be like that of the advance stations of the pioneer in geographical discovery. The fortunate researcher may strike a point, a Mexico or a Peru, whose visible wealth will bring him immediate glory and compel the tide of conquest to set at once in that direction; or it may be a California, which must wait till the slow advance of generations shall make the time ripe for the full development and appreciation of its riches. The history of science is full of these contrasts, as every student knows. Of the latter sort of advances, a fine illustration may be drawn from some of Dr. John W. Draper's researches in actino-chemistry. In papers published thirty years ago, Dr. Draper maintained these two propositions, namely:

1st. That so far from chemical influences being restricted to the more refrangible rays, every part of the spectrum, visible and invisible, can give rise to chemical changes, or modify the molecular arrangement of bodies.

2d. That the ray effective in producing chemical or molecular changes in any special substance is determined by the absorptive property of that substance.

These points were well taken; yet the standard treatises on the solar spectrum continue to teach that only the more refrangible rays have power to produce chemical changes.

In the last issue of the *Philosophical Magazine*, Dr. Draper restates these propositions with an abundance of evidence to prove the current teaching incorrect. Even the so-called curve of chemical intensity, derived from the action of sunlight on the sensitive salts of silver, does not truly represent the range of chemical action in the case. By a careful determination of the habitudes of silver iodide, Dr. Draper finds that every ray in the spectrum acts on that substance, the more refrangible rays apparently promoting, the less refrangible apparently arresting, the action of daylight on it, these contrary effects taking place not only simultaneously but successively, and that when considerable intervals of time intervene.

Again with bitumen and resin—the substances first used by Niepce for photographic purposes—every ray in the spectrum acts, the "proof" being continuous except where the Fraunhofer lines fall.

The rays which act chemically on the carbonic acid of plants—the most important of all actino-chemical operations—are the less refrangible rays, not the more refrangible "chemical" rays, as they are commonly called. Two methods may be employed for proving this fact—by observing the place of maximum evolution of oxygen gas in the spectrum, and by finding the place in which young etiolated plants turn green. The point of maximum action in both cases is in the yellow, the range of action embracing the orange on one side and a portion of the green on the other.

The action of light on the colors of flowers is well known. Years ago these phenomena were observed far enough to determine that nearly every radiation affected some particular color. Thus paper stained yellow by *corchorus japonica* is whitened by green, blue, indigo, and violet rays. The rose red of the ten weeks stock is changed by the yellow, orange, and red; and soon, the general law of such action—discovered by Grothuss and verified by Herschel—being that the rays which are effective in the destruction of any given vegetable color are those which by their union produce a tint complementary to the color destroyed.

In this connection Dr. Draper calls attention to a matter worth examining, namely, that the physiological explanation of sight may hinge on the fact that, like vegetable colors, the retina is a carbon compound, and carbon is affected mainly by rays whose wave lengths are between those of the extreme red and the extreme violet, the maximum being in the yellow. In other words, the chemical curve of carbon in the spectrum is the same as the curve of luminosity, as represented by Herschel. This being the case, the possible development of human vision up to the capacity to measure vibrations now invisible, as suggested by Professor Tyndall in his recent lectures, would depend not on education but on a change in the chemical composition of the retina, which is hardly to be expected. But this is apart from Dr. Draper's memoir.

The action of light on the growth of plant stems and roots proves with equal conclusiveness that it is wrong to restrict the chemical force of the spectrum to any special region. As observed by Dr. Gardner, seeds germinating in darkness develop vertical stems. On exposing such stems to the spectrum a bending movement begins toward the indigo, the stems in the indigo bending toward the approaching ray. Removed into darkness, the stems recover their upright position. Repeating and extending these observations, M. Dubrochet found that plant roots bend from the light, this action being produced by all the colored rays of the spectrum.

In support of his second proposition, namely, that the ray absorbed by any substance is the one which produces chemical effects in it, Dr. Draper reviews at great length the modes in which radiations act on the decomposition of silver iodide, and in the combination of chlorine and hydrogen. Briefly stated, his deductions are as follows:

When a radiation impinges on a material substance, it imparts to that substance more or less of its *vis viva*, and therefore undergoes a change. The substance is also disturbed, its physical and chemical properties determining the phenomena which result.

If the substance is black and undecomposable, the radiation establishes vibrations among the molecules it encounters, each molecule becomes a center of agitation, and heat radiation and conduction in all directions are the result.

If the substance is colored and undecomposable, it will extinguish the rays complementary to its own tint, and its temperature will rise correspondingly.

If the substance is decomposable, the absorbed radiation will be expended in breaking down the union of those particles which have arrested it with their associated particles.

In the last case the effect presents two separate and distinct phases, the physical and the chemical. The first phase, the physical, consists in a disturbance of the group of molecules about to be decomposed. Up to a certain point the dislocation may be checked, stopped, and the original condition restored; but that point once gained, decomposition ensues, and the result is permanent. These phases are happily illustrated by the following familiar example:

"If a sheet of paper be held before a fire, its surface will gradually warm; and if the exposure be not too long or too hot, on removing it the paper will gradually cool, recovering its former condition without any permanent change. One could conceive that the laws of absorption and radiation might not only be studied, but could be again illustrated by the exposure and removal of such a sheet. But a certain point of temperature or exposure gained, the paper scorches, that is, undergoes a chemical change, and then there is no restoration, no recovery of its original condition."

As in his former memoir Dr. Draper demonstrated the heating power of radiations to reside in all equally, whatever their refrangibility, so in this he proves the power to produce chemical changes to be manifested by rays of every refrangibility, different substances being acted on by different rays. In other words, the seeming three-fold nature of radiations is due solely to the character of the substances on which they impinge; those rays which are reflected affect our eyes as light; those which are absorbed set up molecular motions, which manifest themselves as heat or chemical action, according to the constitution of the absorbing substance.

IT is not what we have or what we have not which adds to or subtracts from our felicity. It is the longing for more than we have, the envying of those who possess more, and the wish to appear in the world of more consequence than we really are which destroy our peace of mind, and eventually lead to ruin.

"Engineer," of Youngstown, Ohio, whose interesting letters on boiler explosions have been published in our pages, says: "I have four volumes of your valuable journal bound and I have four more ready to bind. There is not a book in my library that I would not rather part with than the volumes of the SCIENTIFIC AMERICAN."

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Facts for the Ladies.—Mrs. Mary Sanders, Jersey City, N. J., has used her Wheeler & Wilson Lock-Stitch Machine since 1863, constantly, on all kinds of sewing, without repairs, and broken but one needle (accidentally); would not sell it for $1,000 if she could not get another. See the new Improvements and Woods' Lock-Stitch Ripper.

Recent American and Foreign Patents.

Improved Pruning Shears.

Amos R. Moulton, Fall's Branch, Tenn.—This invention relates to an improvement in shears for pruning purposes, whereby they are rendered more effective than the ordinary kind, and it consists principally in the method of producing a drawing or sliding cut upon the branch or limb to be separated, by the employment of a horizontally or obliquely sliding cutter which is operated by means of a pair of hand levers. The second feature of the invention consists in providing the cutting blades with a series of holes which are employed for adjusting the same as it wears away, or for regulating the distance between the cutter and holding jaw.

Improved Feather Renovator.

Edger N. McKimm and John R. Gearhart, Lathrop, Mo.—The invention consists in providing the stirrers of a feather renovator with loops at one end and a hinged concave clamp at the other so that they can be easily detached.

Improved Spring Power for Sewing Machines.

James Cleveland, of Williamsburg, and Charles A. Todd, of New York city.—This invention has for its object to furnish an improved spring power for driving a sewing machine at any desired velocity, and which shall be so constructed that the tension may be readily kept upon the spring, so that the machine may be run continuously for any desired length of time.

Improved Grain Binding Harvester.

Harry H. Bridenthall, Jr., Youngstown, Pa.—This invention has for its object to improve the construction of the harvester for which letters patent No. 120,027, were issued October 17, 1871, so as to make it a self binder; and it consists in the combination of a block, crossed or diagonal rods, and their supports or equivalents with the driving pitman and sickle bar; in suitable mechanism, for the purpose of raising the gavel into contact with the binding device, for the purpose of twisting bands upon and aronnd the grain bundles, for the purpose of forming a straw band around the gavel while being held and rotated by the endless chain; and in the combination of the lever chain and lever for raising the cutter bar with the cutter bar and with the pivoted seat and pivoted standard.

Apparatus for Preparing Roofing Felt.

George W. Pond, Brooklyn, N. Y., assignor to himself, J. W. Smith and J. W. Coolidge, of same place.—The object of the present invention is to improve the machinery employed in manufacturing what is known as roofing felt; and it consists in making the frames of the rollers upon which the felt or paper is rolled adjustable, so that the different rolls of felt or paper, when being drawn from those rollers to be joined together between the feed or compressing rollers, will meet with their edges even and be uniform with each other, thereby obviating the necessity of shearing off the edges of the felt to make them even. It also consists in a device for adjusting the uprights which support the roller to suit the width of the felt or paper.

Improved Corn Planter.

William T. F. Smith, Lexington, Ill.—This invention has for its object to furnish an improved device for planting corn, which shall be so constructed as to enable the corn to be planted in perfect check row. By suitable construction the movement of a rope continuously in the same direction operates the dropping slide alternately in opposite directions, knobs being arranged at such a distance apart as to operate the slide and drop the corn ar the proper points.

Improved Adjuster for Well Drills.

Joseph Gallagher, Shamburg, Penn.—The object of this invention is to provide simple and convenient means for connecting pump rods and drilling rods to the working beam of pumping or drilling machinery; and it consists in a grooved wrist bar and a screw clamp. In attaching the device to the working beam, the part of the bar between the clamp and the wrists is inserted in a slot in the end of the beam. The whole device will then hang vertically with the wrists resting in a shallow groove on the top of the beam. It is then made fast to the beam by a slotted timber bolted fast over the wrists. When thus connected the adjuster is ready for use either fo pumping or drilling, the hook being used in the former case and the straight rod in the latter, which may be drawn into the groove in the bar sufficiently tight to be held by the friction alone. This device may, therefore, be used for either pumping or drilling without removing it from the working beam

Improved Glove.

James I. McMartin, Johnstown, N. Y.—The invention consists of a single glove pattern, by which the thumb may be cut in one piece if made entirely of leather, or of two pieces if made with leather front and cloth back.

Improved Bolt Trimmer.

William Dunlop, Fullarton, Canada.—This invention is an improvement in the class of bolt trimmers in which a cutting tool or chisel is reciprocated by a rack bar and toothed segment. The forward end of the lower lever of the implement is made wide and has a slot formed in it to receive the operating parts of the device. A block slides back and forth upon ways formed upon the lower parts of the inner surfaces of the side bars that form the slot, and which is held down to its place by stays attached to said surfaces. In a recess in the forward part of the lower side of the block is secured a chisel, the lower side of which is flush with the lower side of the lever. The edge of the chisel, when the block is pushed forward, strikes against a steel cushion secured to the inner surface of the forward end of the lever. The lower edge of the end of the lever and the lower end of the plate project a little below the lower surface of the lever to rest against the edge of the nut, while the lower side of said handle rests upon the face of said nut, and the chisel shaves off the projecting end of the bolt. Upon the upper side of the rear part of the sliding block is formed gearing connecting with the end of the upper lever. The forward end of the lever is pivoted to projections formed upon the rear parts of the upper edges of the slotted forward end of the lower lever, so that the sliding block and chisel may be drawn back by raising the free end of the lever, and forced forward to make a cut by rcing the said end downward.

Improved Cigar Perforator.

Eibertus A. Konter, Brooklyn, N. Y., assignor to himself and W. M. Hawkins, of same place.—The invention relates to the well known cigar end piercers containing a tapered guide tube with one or more knives fastened therein, and sometimes provided with an eye on the outer part of closed end, by which it may be attached to a chain and hung from a watch or from the person. The invention consists in the mode of constructing the several parts so as to render them conveniently detachable from each other, and so that thus any one can be easily replaced or the knives sharpened.

Improved Corn Planter.

Joshua McGinnis, Frazeysburg, O., assignor to himself and E. L. Lemeret, of same place.—The box to receive the grain is provided with a cover, which is kept in place by a spring catch. The bottom of the box is made thick, and has a hole formed through it near one end to allow the corn or other seed to pass through to the dropping slide. The lower part of the hole through the bottom is enlarged upon the side toward the central line of the seed box, and has a brush placed in said enlarged part to prevent any more seed passing out than enough to fill the hole in the dropping slide. The dropping slide, which moves back and forth in a square groove formed in the under side of the bottom, is held up in place by a block or plate, placed in a notch in the bottom and held up against the dropping slide by a spring. In the dropping slide is formed a hole to receive the seed from the hole in the bottom and carry it out of said box, the block or plate keeping the seeds from dropping out of the hole before they have been carried to the proper position. The amount of seed dropped out at a time depends upon the thickness of the slide. In the slide, near its end, is formed a second hole to receive any seeds that may pass through or beneath the brush to prevent the machine from becoming clogged. As the seeds drop from the slide they fall into the hopper shaped spout, by which they are conducted into the receiver

Improved Paint Brush.

Lavine A. Lightenhome, Chicago, Ill.—This invention relates to an improvement in the class of paint and varnish brushes whose bristles are secured in a tapered or conical ring and their handles in the socket of a cap or disk adapted to screw into the same. The improvement consists in a mode of securing the bristles more efficiently than heretofore by means of cement, which is placed in the space or cavity between the screw cap and heads of the bristles, and forced into or among the same by driving the handle into its socket.

Improved Gates.

William B. Smith, Copper Creek, Ill.—The invention relates to means for opening double gates. The two gates have high posts, by which they are hinged to permanent posts for being coupled overhead by cross and parallel bars, so that one gate will be opened and closed by the other, the said gates swinging in opposite directions. Long rods, attached to one of the gates and extending each way along the road, serve for opening and closing the gates without dismounting. The said rods, being longest and heaviest at the outer sides of their pivots, hold the latch up and keep the gate fastened. They are lifted up when taken hold of to operate the gates for unlatching them. The lower hinge of the gate is movable up and down the post for shifting the gate higher or lower by the withdrawing of the staple from one of the holes and putting it in another but the staple of the upper hinge, being connected to a long staple on the gate, allows the gate to slide up and down freely as much as required, so that the gate may be readily raised in winter above the snow and let down again when the snow is gone.

Improved Reciprocating Steam Engine.

Charles E. Lamb, Wauseon, O.—The distinguishing features of this invention are the arrangement and operation of an oscillating valve in the piston of the engine and the manner of introducing and exhausting the steam. On the end of a tubular piston rod a valve is arranged, within the center of the piston, and receives a rotary motion sufficient to change the ports and allow the cylinder to take and exhaust steam at both ends at each stroke of the engine. This rotating motion is produced by means of a pin in the crotch of the connecting rod. On the end of the hollow piston rod is a collar, with two projecting lugs, between which lugs the pin works. The collar is made adjustable. By means of this adjustment the valve is changed or set so as to cut off the steam sooner or later, as may be required. The extent of this revolving motion depends upon the distance of the pin from the center of the cross head. This distance is always supposed to be sufficient to turn the valve and change the ports as the crotch of the connecting rod is carried up and down by the engine crank. The steam is admitted through a tube, which is screwed into the end of the valve on the opposite side of the piston. This tube reciprocates in and is inclosed by an outside tube which connects with the boiler. As the piston works back and forth in the cylinder it is prevented from turning or partaking of the revolving motion of the valve by means of the straight rod which passes through the piston and is confined in the cylinder heads. The positions of the valve are reversed at every stroke of the engine, and the steam is admitted and performs its work and is exhausted with the same regularity and precision as with the ordinary slide valve, all the steam being admitted through a suitable pipe and exhausted through the hollow piston rod.

Improved Cotton Cleaner.

James L. Coker, Hartsville, S. C.—This invention has for its object to furnish an improved attachment for cotton gins for cleaning the cotton and feeding it to the gin, removing nails, sand, and other impurities from the cotton, and feeding it uniformly to the gin. The two sides and the upper part of the front end of the frame of the machine are closely incased. The upper part of the top in the rear of the sweeper and the rear end is inclosed with wires or slats inclining inward to allow sand, nails, etc., to drop through. The upper front part of the machine is left open at the top to serve as a hopper to receive the cotton, which rests upon the endless apron, which is formed by attaching cross slats to bands or belts which pass around the rollers. The slats of the endless apron are provided with points to take hold of the cotton and carry it forward. The sweeper is formed by attaching knives or plates in an inclined position. The sweeper may be adjusted to allow more or less cotton to pass through to the gin, as may be desired. And it is revolved in such a way as to push the cotton back from the upper end of the carrier and allow only the desired amount of cotton to be carried to the beater. The beater is formed by attaching numerous teeth to a cylinder, which receives the cotton from the carrier and knocks out the sand, nails, and other impurities, which fall through the slatted or wire back of the machine while the cotton slides down said back to the cleaning cylinders, one or more of which are used. The cylinders are covered with leather having wire or card teeth attached to it, or the card teeth may be attached directly to the said cylinder. The cylinders further clean the cotton by shaking it and rubbing it against a board secured above the said cylinders, and which is concaved and corrugated. A brush cylinder takes the cotton from the last cleaning cylinder and discharges it between the guide boards or aprons to the gin.

Improved Converting Motion.

Taylor D. Lakin, Greenfield, N. H.—This invention relates to a new mechanical movement in which a right or left hand nut are arranged within a cylindrical or other case, and surrounding a threaded spindle. When the said cylindrical case is moved longitudinally—that is to say, parallel to the axis of said spindle—it will cause the latter to be revolved continuously in the same direction. This movement will be of great advantage for various purposes; for hand tools as well as for larger machinery, such as augers, drills, shafts, etc.

NEW BOOKS AND PUBLICATIONS.

A POPULAR TREATISE ON GEMS; a Guide for the Teacher of Natural Sciences, the Lapidary, Jeweller, and Amateur. With Illustrations. Fourth Edition. By Dr. L. Feuchtwanger, Chemist and Mineralogist, Member of the New York Lyceum of Natural History, etc. etc. Published by the Author, 55 Cedar Street, New York city.

This is a republication of a work of known value, which has long been a standard authority on its subject. The information in this edition has been carried down to the latest date; and the illustrative lithographs are numerous and valuable, the text being elucidated by wood cuts in great profusion

DECISIONS OF THE COURTS.

United States Court.

BILLIARD TABLE PATENT.—LEVI DECKER *vs.* FREDERICK GROTE, *et al.*

BLATCHFORD, *Judge.*

This suit is brought on reissued letters patent, granted to the plaintiff March 9, 1869, for an "improvement in cushions for billiard tables," the original patent having been granted to him December 18, 1866. The specification of the reissued patent says: "My invention has for its object the preservation of cushions for billiard tables against the impact of the ball. The nature of my invention consists in the employment or use of a catgut or other strong cord, located in or at the upper corner or edge of the cushion, and immediately at the point against which the ball strikes when the game of billiards is played.

Decree for the plaintiff, for a perpetual injunction, and an account of profits, and an ascertainment of damages, with costs.

W. J. A. Fuller, for the plaintiff.
B. F. Lee and *A. Pollak*, for the defendants.

Inventions Patented in England by Americans.

[Compiled from the Commissioners of Patents' Journal.]

From December 21 to December 31, 1872, inclusive.

BOOTS, ETC.—T. H. Dodge, Worcester, Mass.
CARBONIZING CLAY, ETC.—G. H. Smith (of New York city), London, Eng.
FILLING MOLDS WITH CLAY, ETC.—G. H. Houghton, Marlin, Texas.
ILLUMINATING LIQUIDS.—J. Hale, Jr., Cincinnati, Ohio.
MAKING STEEL, ETC.—T. R. Scowden, Cincinnati, Ohio.
MOWER AND REAPER.—W. A. Wood, Hoosick Falls, N. Y.
PISTOL.—W. J. Morris (of New York city), London, England.
PRINTING TELEGRAPH.—G. M. Phelps, Brooklyn, N. Y.
RAG TEARING MACHINE.—A. Peple, Lowell, Mass.
SCOURING NEEDLES, ETC.—Mallett Manufacturing Co., New Haven, Conn.
TRIP HAMMER.—C. C. Bradley, Syracuse, N. Y.
WHEEL FOR VEHICLE.—O. S. Vreeland, Salamanca, N. Y.

Value of Patents,

AND HOW TO OBTAIN THEM.

Practical Hints to Inventors.

PROBABLY no investment of a small sum of money brings a greater return than the expense incurred in obtaining a patent even when the invention is but a small one. Larger inventions are found to pay correspondingly well. The names of Blanchard Morse, Bigelow, Colt, Ericsson, Howe, McCormick, Hoe, and others, who have amassed immense fortunes from their inventions, are well known. And there are thousands of others who have realized large sums from their patents.

More than FIFTY THOUSAND inventors have availed themselves of the services of MUNN & Co. during the TWENTY-SIX years they have acted as solicitors and Publishers of the SCIENTIFIC AMERICAN. They stand at the head in this class of business; and their large corps of assistants, mostly selected from the ranks of the Patent Office: men capable of rendering the best service to the inventor, from the experience practically obtained while examiners in the Patent Office: enables MUNN & Co. to do everything appertaining to patents BETTER and CHEAPER than any other reliable agency.

HOW TO OBTAIN *Patents.*

This is the closing inquiry in nearly every letter, describing some invention which comes to this office. A *positive* answer can only be had by presenting a complete application for a patent to the Commissioner of Patents. An application consists of a Model Drawings, Petition, Oath, and full Specification. Various official rules and formalities must also be observed. The efforts of the inventor to do all this business himself are generally without success. After great perplexity and delay, he is usually glad to seek the aid of persons experienced in patent business, and have all the work done over again. The best plan is to solicit proper advice at the beginning. If the parties consulted are honorable men the inventor may safely confide his ideas to them; they will advise whether the improvement is probably patentable, and will give him all the directions needful to protect his rights.

How Can I Best Secure My Invention?

This is an inquiry which one inventor naturally asks another, who has had some experience in obtaining patents. His answer generally is as follows and correct:

Construct a neat model, not over a foot in any dimension—smaller if possible—and send by express, prepaid, addressed to MUNN & Co., 37 Park Row, New York, together with a description of its operation and merits. On receipt thereof, they will examine the invention carefully, and advise you as to its patentability, free of charge. Or, if you have not time, or the means at hand, to construct a model, make as good a pen and ink sketch of the improvement as possible and send by mail. An answer as to the prospect of a patent will be received, usually, by return of mail. It is sometimes best to have a search made at the Patent Office; such a measure often saves the cost of an application for a patent.

Preliminary Examination.

In order to have such search, make out a written description of the invention, in your own words, and a pencil, or pen and ink, sketch. Send these with the fee of $5, by mail, addressed to MUNN & Co., 37 Park Row, and in due time you will receive an acknowledgment thereof, followed by a written report in regard to the patentability of your improvement. This special search is made with great care, among the models and patents at Washington, to ascertain whether the improvement presented is patentable.

Rejected Cases.

Rejected cases, or defective papers, remodeled for parties who have made applications for themselves, or through other agents. Terms moderate, Address MUNN & Co., stating particulars.

To Make an Application for a Patent.

The applicant for a patent should furnish a model of his invention if susceptible of one, although sometimes it may be dispensed with; or, if the invention be a chemical production, he must furnish samples of the ingredients of which his composition consists. These should be securely packed, the inventor's name marked on them, and sent by express, prepaid. Small models, from a distance, can often be sent cheaper by mail. The safest way to remit money is by a draft, or postal order, on New York, payable to the order of MUNN & Co. Persons who live in remote parts of the country can usually purchase drafts from their merchants on their New York correspondents.

Caveats.

Persons desiring to file a caveat can have the papers prepared in the shortest time, by sending a sketch and description of the invention. The Government fee for a caveat is $10. A pamphlet of advice regarding applications for patents and caveats is furnished gratis, on application by mail. Address MUNN & Co., 37 Park Row, New York.

Reissues.

A reissue is granted to the original patentee, his heirs, or the assignees of the entire interest, when, by reason of an insufficient or defective specification, the original patent is invalid, provided the error has arisen from inadvertence, accident, or mistake, without any fraudulent or deceptive intention.

A patentee may, at his option, have in his reissue a separate patent for each distinct part of the invention comprehended in his original application by paying the required fee in each case, and complying with the other requirements of the law, as in original applications. Address MUNN & Co., 37 Park Row, for full particulars.

Trademarks.

Any person or firm domiciled in the United States, or any firm or corporation residing in any foreign country where similar privileges are extended to citizens of the United States, may register their designs and obtain protection. This is very important to manufacturers in this country, and equally so to foreigners. For full particulars address MUNN & Co., 37 Park Row. New York.

Canadian Patents.

On the first of September, 1872, the new patent law of Canada went into force, and patents are now granted to citizens of the United States on the same favorable terms as to citizens of the Dominion.

In order to apply for a patent in Canada, the applicant must furnish a model, specification and duplicate drawings, substantially the same as in applying for an American patent.

The patent may be taken out either for five years (government fee or $20) for ten years (government fee $40) or for fifteen years (government fee $60) The five and ten year patents may be extended to the term of fifteen years The formalities for extension are simple and not expensive.

American inventions, even if already patented in this country, can be patented in Canada provided the American patent is not more than one year old.

All persons who desire to take out patents in Canada are requested to communicate with MUNN & Co., 37 Park Row, N. Y., who will give prompt attention to the business and furnish full instruction.

Address

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37 Park Row, New York.

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Nickel Plating; a new and superior mode, not infringing Patents, for sale and references given by A. Scheller, 121 Forsyth Street, New York.

For Sale, Cheap—First class McAllister's Oxy-hydrogen Stereopticon. Address Rev. A. C. Hubbard, Danbury, Conn.

Patent Gearing—Great Strength, Durable, Noiseless, Cheap. J. Comly, 148 Ten Eyck St., Williamsburgh, N. Y.

Special attention paid to Hammering or Trueing of large Circular and Shingle Saws. Also, Retoothing. Address J. Tattersall, 26 Carroll St., Elmira, N. Y.

Traction Engines and Plows. Address W. H. H. Heydrick, Chestnut Hill, Philadelphia.

Hydraulic Presses and Jacks, new and second hand. E. Lyon, 470 Grand Street, New York.

Selden Packing, for stuffing boxes. Circulars, &c., mailed free. 8½ Oliver St., Boston, Mass.

Foot Lathe for $22. Goodnow & Wightman, 23 Cornhill, Boston, Mass.

Wanted, reliable and responsible parties to Sell Engines, Saw Mills, and other machinery manufactured by the Mansfield Machine Works, Mansfield, Ohio.

For the Best Circular Saw Mills and Steam Engines, Stationary and Portable, of all Sizes, apply to the Mansfield Machine Works, Mansfield, Ohio.

For Wait's Improved Turbine Water Wheels, Improved Mulay, Gang, and Circular Saw Mills, Paper Engines, Rope Cutters, &c. &c., address Marihew & Van Wormer, Successors to P. H. Wait, Sandy Hill, N. Y.

Plow Shares, Mold Boards, Cultivator Teeth, &c., cast to order, by Pittsburgh Steel Casting Co., Pittsburgh, Pa., of steel which can be worked same as wrought steel. All work warranted.

All Blacksmith Shops need a Holding Vise to upset bolts by hand. For such, address J. R. Abbe, Manchester, N. H.

"Mills' Patent Lifting Cams" for Self Stripping Cards. 38,000 in use. Address John F. Foss, Lowell, Mass.

For sale, at any price, six hundred barrels of sour ale. Want to use the casks. Address Room 107, Earle's Hotel, New York City.

Circular Saw Mills, with Lane's Patent Sets; more than 1200 in operation. Send for descriptive pamphlet and price list. Lane, Pitkin & Brock, Montpelier, Vermont.

Wanted Situation—Thoroughly understands building, setting up, and running Wood Working Machinery. Would prefer going South. H.Inman, Troy, N.Y.

Manufacturers who can furnish Trunk Board 38 to 40 ins. square, please address Sullivan Machine Company, Claremont, N. H.

First Class Bed and Platen Printing Presses to order on short notice by Sullivan Machine Company, Claremont, N. H.

Machinists—Price List of small Tools free; Gear Wheels for Models, Price List free; Chucks and Drills, Price List free. Goodnow & Wightman, 23 Cornhill, Boston, Mass.

Electro Gold and Silver Plater, of 12 years' experience, is open for an engagement. Address S. C., 99 Union St., Newark, N. J.

Wanted, by T. R. Bailey & Vail, Lockport, N. Y., Planer, new or second hand, to plane 5 to 6 ft. long, 20 to 26 inches wide.

All Fruit-can Tools, Ferracute, Bridgeton, N.J

Nickel Salts and Ammonia, especially manufactured for Nickel Plating, also "Anodes," by L. & J. W. Feuchtwanger, 55 Cedar Street, New York.

"Minton & Co.'s Tiles," by appointment, Gilbert Elliott & Co., Sole Agents, No 1 Clinton Place, 8th St., New York.

English Patent—The Proprietors of the "Heald & Cisco Centrifugal Pump" (triumphant at the recent Fairs), having their hands full at home, will sell their Patent for Great Britain just obtained. A great chance for business in England. Address Heald, Sisco & Co., Baldwinsville, N Y.

For the best Presses and Dies and all Fruit Can Tools, apply to Bliss & Williams, 118 to 120 Plymouth St., Brooklyn.

American Boiler Powder, for certainty, safety, and cheapness, "The Standard anti-incrustant." Am. B. P. Co., Box 797, Pittsburgh, Pa.

Scale in Boilers. I will Remove and prevent Scale in any Steam Boiler, or make no charge. Send for circular. Geo. W. Lord, Philadelphia, Pa.

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Steel Castings "To Pattern," from ten lbs. upward, can be forged and tempered. Address Collins & Co., No. 212 Water St., N. Y.

Dickinson's Patent Shaped Diamond Carbon Points and Adjustable Holder for dressing emery wheels, grindstones, etc. See Scientific American, July 21 and Nov. 20, 1869. 64 Nassau St., New York.

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T. R. Bailey & Vail, Lockport, N. Y., Manf. Gauge Lathes.

Boynton's Lightning Saws. The genuine $500 challenge. Will cut five times as fast as an ax. A six foot cross cut and buck saw, $6. E. M. Boynton, 80 Beekman Street, New York, Sole Proprietor.

Williamson's Road Steamer and Steam Plow, with rubber Tires. Address D. D. Williamson, 32 Broadway, N. Y., or Box 1809.

For Steam Fire Engines, address R. J. Gould, Newark, N. J.

Brown's Coalyard Quarry & Contractors' Apparatus for hoisting and conveying material by iron cable, W. D. Andrews & Bro. 414 Water st. N. Y.

Wanted to purchase, six good second hand Milling Machines, two extra heavy. Address P. O. Box 258, New Haven, Conn.

Belting as is Belting—Best Philadelphia Oak Tanned. C. W. Arny, 301 and 303 Cherry Street, Philadelphia, Pa.

Peck's Patent Drop Press. For circulars, address the sole manufacturers, Milo, Peck & Co., New Haven, Conn.

Mining, Wrecking, Pumping, Drainage, or Irrigating Machinery, for sale or rent. See advertisement, Andrew's Patent, inside page.

For Solid Wrought-iron Beams, etc., see advertisement. Address Union Iron Mills, Pittsburgh, Pa., for lithograph, etc.

A New Machine for boring Pulleys, Gears, Spiders, etc. etc. No limit to capacity. T. R. Bailey & Vail, Lockport, N. Y.

The Berryman Heater and Regulator for Steam Boilers—No one using Steam Boilers can afford to be without them. I. B. Davis & Co.

Always right side up—The Olmsted Oiler, enlarged and improved. Sold everywhere.

Gatling guns, that fire 400 shots per minute, with a range of over 1,000 yards, and which weigh only 125 pounds, are now being made at Colt's Armory, Hartford, Conn.

Notes & Queries

1.—D. B. asks: How is the gelatin used in plaster casting made?

2.—G. S. asks: How is the cement with which the collars are fastened to glass lamps made?

3.—J. A. P. asks: What is the best preparation for filling the holes and seams in an open French burr for grinding wheat?

4.—L. M. L. asks: If the air be suddenly exhausted from the inside of a vessel, will the temperature in the inside remain the same as the air surrounding it?

5.—J. B. C. asks: How can I make a show case for a drug store, to contain all kinds of liquors or spirits in one glass without their mixing?

6.—A. B. C. says: I want a recipe for making a water and steam proof glue or cement that will fasten pieces of wood as firmly together as the ordinary glue.

7.—H. G. B. asks: Where can I obtain the many kinds of patterns used on stained and frosted glass?

8.—G. R. B. asks: What is a good composition to prevent rust on gun barrels? It should be of a dead black color, as a bright barrel often frightens the game.

9.—A. L. N. asks: Will some good mechanic, of the many thousands who read the SCIENTIFIC AMERICAN, give me a rule for drafting a link for a steam engine?

10.—E. asks: What are the simplest methods of softening and molding horn; also of making and molding papier mache?

11.—G. R. B. asks how the wire of Weinhold's acoustic telegraph, described by us on page 352 of volume XXVI., is to be insulated. Is it to be insulated as for electricity, or to be kept from anything that will deaden the sound? Should the mouth pieces be soldered to the wire?

12.—J. D. W. asks: How can I make a mold for casting a small cylinder 2 x 4 inches for slide valve engines? Will lead or block tin be a good metal to make it of?

13.—A. L. asks: What will destroy or neutralize the narcotic properties of tobacco while being smoked in a pipe?

14.—E. P. M. wants to know how to coat pins 1½ inches long, of ⅛ inch wire with zinc.

15.—M. and L. ask: Can some one inform us of a compressed paper packing, used instead of Babbitt metal for journals and railroad boxes?

16.—J. L. H. asks: Is there any known process by which inkstains can be removed from lawn, printed with violet flowers on a white background? The ink is a mauve writing fluid.

17.—E. E. E. asks: Can any one give a process, other than distillation, for determining when all the spirit in cider, or other fermented liquids is acetified? How many grains of crystalized carbonate of soda should an ounce (960 grains) of good marketable vinegar saturate?

18.—C. H. K., of Ind., states as a curious fact that the "epizootic" is more injurious to the jacks and jennets than to the horses. To many of the former the distemper has proved fatal in the West. Our correspondent asks why it is.

19.—C. R. M. says: I want a recipe for a cement to stick flannel to iron rolls, something that will stick tight and dry quick. I am using a cement composed of 9 parts white lead, 1 part Venice turpentine; but it requires from 7 to 10 days to dry. What can be added to it that will make it hard in a much shorter time?

20.—A correspondent says: Although much has appeared from time to time in this and other journals in regard to the employment of soluble glass, there is still room for information in regard to its practical use. Its application for covering wood is very much limited by the fact of its solubility in cold water. Soluble glass ordinarily met with in the shops, though hard and polished when dry, will absorb sufficient moisture on a damp day to destroy this surface. I have tried the expedient recommended by some, of previously washing the surface to be painted with a solution of common salt or with lime water, in order that, upon the application of the soluble glass, a silicate of soda or of lime may be formed, but I have met with only indifferent success. I have seen it stated in a recent English periodical that soluble glass—a silicate of soda or of potash, or of both, as the case may be—is now made by using a smaller proportion of the alkali than formerly, and preparing the solution, under pressure, at a temperature of over 300°. By this means, a soluble glass that is not acted upon in any degree by cold water (and not even by hot water, unless under a pressure and at a temperature equal to that at which it was originally prepared) is said to be produced. Can you give any information as to the question? In default of any information on this point, can you give any rule for the employment of the soluble glass commonly in use, so that it can be made available? Most of the so-called mineral paints consist largely of this, but they also contain benzine of villanous smell. I want an inodorous preparation that shall be unaffected by cold water.

Answers to Correspondents

P. B. says: There are a number of boilers being altered from feeding through mud pipes to feeding at top into perforated pipes, four feet long and four inches above the flue. Is there any advantage? Answer: It is not unlikely that feeding into a perforated pipe just above the flues of a boiler, rather than into the mud drums, may allow a more ready settlement of mud and deposits in the drums, and it will have the advantage of equalizing the temperatures of the different portions of the boiler, and thus preventing injury by consequent strains. Care should be taken to feed constantly, if possible, and regularly, otherwise it will be difficult to keep the steam pressure steady.

J. M. M. asks: Do you know of any instrument that will correctly indicate the heat of molten metals? What is its name and where may it be obtained? Answer: Pyrometers are used to determine temperatures too high to be indicated by the thermometer, but we know of none that are very reliable at temperatures exceeding 1,000° or 1,200° Fahr. You may use one for lead, but cast iron melts at a temperature of 2,744° Fahr., according to some authorities; and this is beyond the reach of reliable indicators of temperature.

K. W. asks: Is there any transparent varnish suitable for varnishing paper, that is not affected by the action of muriatic acid? Answer: Paper can be effectually protected from the corroding action of hydrochloric and other acid fumes by painting it with a solution of paraffin in petroleum naphtha. Paper trays have been made for photographers' use by simply coating ordinary paste board with paraffin. Such trays will resist the action of silver salts, or other acids, quite as well as gutta percha or india rubber.

C. B. asks: What is the best ink or edge color for shoemakers? We can get plenty of ink, but it will not take in leather. Answer: One of the best blacks for coloring edges can be made from iron filings and pure cider vinegar. Put the iron filings, shavings, or scraps in an iron kettle, cover them with good cider vinegar and allow the mixture to stand two months, stirring frequently; then strain off the liquor and store in small bottles. It will produce a true black, that will not turn blue after exposure, like vitriol black.

D. G. asks: What are the objections to melting brass in a wrought iron ladle made in the same form as a crucible? I suppose that a certain amount will adhere to the iron on its first use, but it will not continue to accumulate. A ladle of iron as above will not break as a common crucible does, and could be heated in a shorter time. Answer: The iron ladle would soon burn out. Fire clay or graphite crucibles are prepared for the manufacture of brass, and in casting it use is made of granite molds, surrounded by a thick coating of clay and cow dung. Sand molds can also be employed.

P. H. S. asks: Have any experiments been tried to supply the place of fire brick in lining cupolas, by the use of cool water, by using a double cylinder or boiler, one say three inches smaller than the other, forming a cavity between their walls, which shall be made water tight by connecting them at bottom and top, and inserting a pipe at top of larger size than the waste pipe at bottom, so as to secure a constant supply of cool water between the walls of the outer and inner cylinder, and thus prevent the heat from destroying the inner wall of the cupola? Answer: We know of no such experiment. The idea is not new, however. See our reply to another and earlier correspondent.

J. M. McG. says: What power of engine is required to run a machine for cutting a bar of iron ⅝x5 inches wide diagonally, the cut being 30 inches long? It is to be cut by the pressure or stroke of one die square down over the edge of another, the die to have a two inch stroke actuated by connecting rod and crank on driving shaft. How many strokes per minute will be practicable, and will it be more economical to heat the bar or to cut it cold? Answer: For such work, a powerful machine is needed. If much work is to be done, and the machine is to be kept continuously in operation, we should advise heating the bars, by all means. If the machine is only occasionally used, the bars may probably be best worked cold. If the bars are heated, a much lighter machine will do the work. Probably ten strokes a minute will be as many as will be found convenient. See that the shears have a heavy fly wheel, and try an engine of five horse power. The power required will depend very greatly upon the construction of the shears, and the character of the intermediate connection, and may vary considerably under differing circumstances.

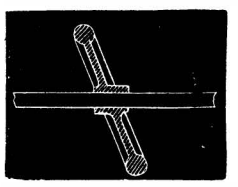
B. says: In a dispute regarding the number of feet, board measure, in a stick of timber, eight inches square at one end and four inches square at the other and twenty four feet long, some claim that it should be measured in the middle, which would make 72 feet, and others that the right way is to measure the contents of each end and average it, which would make 80 feet. I think neither right. Answer: To obtain the volume, in cubic feet, of a tapering stick of squared timber: add together the areas of the end and four times the area of the section at the middle of its length, measured in square feet, and multiply the sum by one sixth the length of the stick. The product is the cubic contents in feet. This product divided by twelve gives, as a quotient, the contents in feet, in board measure.

P. Bros., say: We have mills here, and our power is steam; we bought a steam gage a short time ago, made by the Utica Steam Gage Co., Utica, N. Y. When our safety valve is blowing off, the gage indicates 60 lbs. The dimensions of safety valve are 2¼ inches diameter, lever 22½ inches long from fulcrum to weight, center of valve 2½ inches from fulcrum, and the action of lever 20 lbs. We estimate the pressure at 100 lbs., nearly. We exchanged the steam gage for another of the same kind and make, and find it the same as the first one. Are they correct, or are we right in calculating the pressure on valve? Answer: The pressure on the stem of the safety valve must be: 42 multiplied by 22½ divided by 2¼ equals 378 pounds, *plus* the pressure due the weight of the lever, the size of which our correspondents do not give. The area of a safety valve 2¼ inches in diameter is 3·976 square inches. The pressure per square inch required to raise the valve described would be: 378 divided by 3·976 equals 95 lbs., and probably the additional weight of the lever would make it very nearly 100 pounds. Have not our correspondents erred in the measurement of the valve? If it has happened that the given measure is the diameter at the inner edge of the bearing surface, and that the bearing is actually at the outer circumference of the seat, the proper diameter for calculation will be the latter, which we presume may be 2⅝ inches, at least. The area of a circle 2⅝ inches diameter is 6·491 square inches, and 378 divided by 6·491 equals 58¼ pounds. The additional pressure due the weight of the lever may bring it up to 60 pounds as shown by gage.

R. F. L. says: I am about to rebuild my saw mill; I own two engines and wish you to tell me which I had better use in the new mill. The engine now in use was built in Louisville, Ky., about forty years ago, but was bored out and a new piston, with cast iron rings, put in some six years ago. The cylinder is 18 inches by 4 feet 6 inches stroke, has slide valve, poppet valve, and a cut-off cutting off steam at ⅝ and expanding ⅜, and is run at 40 revolutions per minute with 90 pounds of steam in boiler. The steam pipe is 5 inches diameter with butterfly valve controlled by Porter governor. There is no bed plate, but the engine is bolted to heavy cylinder timbers. This engine gives me plenty of power to drive two 8 feet muley saws, and one 5 feet circular saw, with edgers, shingle, and lathe machines, cut-off saw, etc. I have an engine built by George Page & Co., of Baltimore, Md., in 1860, it rests on an iron bed plate, and is 15 inches by 2 feet stroke: has double slide valves, one on top of the other; the cut off is variable at pleasure, the exhaust steam jackets the cylinder, and there is a balanced valve in steam pipe controlled by a Porter governor. What I wish to know is: Will the Page engine with its modern improvements develope as much power as the old Louisville engine, carrying the same boiler pressure? Which one would you advise me to use? Answer: We should suppose that the old engine would develop considerably the most power, if its steam and exhaust passages are not too small, while the new engine should be the more economical. If there is a doubt whether the new engine will supply sufficient power, and if the difference in economy of fuel is no objection, it would be best to use the old engine, if it remains in good order. If a little more steam can be safely carried so as to bring up the power of the new engine, it would be better to try that. We cannot advise taking the slightest risk, however, to secure economy of fuel.

L. M. L. asks: How many pounds pressure to the square inch will it take to explode a tube constructed of the best boiler iron, 10 feet long, inside diameter 2 inches, outside diameter 3 inches. Answer: A tube of any length, of two inches internal diameter, three inches outside diameter, and of iron capable of bearing a tensile strain of 50,000 pounds per square inch of section would sustain an internal pressure of 19,230 pounds. A thick cylinder has less proportional strength than a thin one, and, in the case mentioned, no amount of thickness that could be given to a cylinder of such iron would enable it to bear a pressure of 50,000 pounds per square inch. The figure given is obtained by use of the usual rule for thick cylinders.

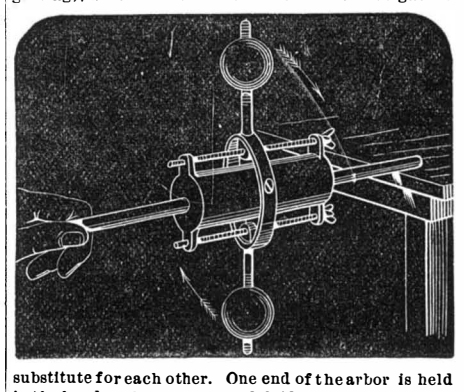
R. and W. say: R. affirms that a balance or fly wheel, if in standing balance, or each side of equal weight, need *not* be at right angles to the shaft, to run fast without affecting the *steadiness of the shaft*. Also that it may be keyed on at even 45° to the shaft without affecting it, except so far as the air may do so, as shown in the engraving W. asserting the contrary.



The one mistaken is to pay five years subscription to your paper for the benefit of him whose premises prove correct. Answer: If a balance wheel is accurately balanced and is perfectly symmetrical in form, and if it is keyed firmly on its shaft in any position except with its plane at right angles to the line of the shaft it will always tend to turn itself until its axis shall coincide with the center line of the shaft. This effort will be a constant one, tending to bend the shaft, but does not necessarily produce unsteadiness in the shaft, as will be readily seen if the experiment be tried. R. is right.

We republish the above from our paper of December 21, for the purpose of correcting the last sentence. It should have read as follows: W. is right.

The attention of S. W. H. and others who have written to us in reference to the matter is called to this correction. The discussion of this subject of balancing machinery has called forth a variety of interesting communications. The accompanying diagram, sent to us by J. C., gives the form for a very effective little device, by which practical experiments on the subject may be made. In respect to this instrument, J. C. says: I notice that the balancing of machinery is exercising the minds of many of your readers. I wish to suggest a little instrument that I have found to practically demonstrate that a standing balance is not necessarily a running balance, and also to refute the false teachings of some of our text books. It is made about 6 inches long, with the other dimensions in proportion (see engraving), with a number of balls of different weights to



substitute for each other. One end of the arbor is held in the hand, and the other end laid on a support: the arm is then struck with the other hand, and the instrument made to revolve. When in running balance, there will be no vibration of the arbor. The hand will detect the least vibration when not in running balance.

W. B. sends mineral specimens, and asks what they are. Answer: The specimens are galena, a valuable ore of lead. The blue and green incrustation is carbonate of copper.

A. H. B. sends samples of pebbles and granite, and asks if they are indications of diamonds? The colored pebbles are very hard; nothing but a diamond will scratch them. Answer: The pebbles are quartz, chalcedony and jasper. They can be scratched by beryl, topaz, ruby and emery. There is no reason why the diamond should not be found in their company; but the best proof of its existence is the finding of it.

T. B. G. encloses six specimens and asks what they are. Answer: All the specimens are clay, in different degrees of consolidation. Nos. 1 and 2 are clay-slate, not fire clay; fire clay is highly siliceous, and this is not. No. 5 is simply a ferruginous clay.

G. B. D. says, in answer to T, query 21, page 10, Vol. XXVIII: The difficulty in dovetailing beveled boxes, such as hoppers, etc., is not in laying out the dovetailing itself, but is rather in preparing or shaping the ends of the boards to be joined. To do this, bevel the upper edge of the boards so that, when they are set up at the angle at which you wish make the hopper, their

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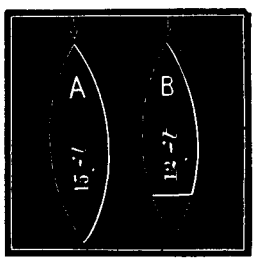
upper edges will be level. Then lay off the angle or bevel of the hopper on the outside of the board and square across the beveled or upper edge, as you would in making a square box. The board being cut to these lines is now ready for laying out the dovetails at right angles from the ends, same as in square work.

To J. H. R., query 16, page 10.—Gum shellac varnish (shellac dissolved in alcohol) will do to coat a canvas boat with: give three or four coats, and the canvas will be perfectly waterproof. Or put three coats of asphaltum varnish on outside and in: it will stand well. Finely ground lamp black in turpentine and Japan dryed make a perfectly indestructible light paint.

J. B. S. says: A friend claims that pier A in the accompanying diagram will offer less resistance to the current of a stream flowing in the direction indicated by the arrows, than pier B will.



I say that the resistance ceases at the greatest lateral diameter of both piers, and that it makes no difference whether the beak be pointed or blunt, in other words, whether the space behind pier B be filled with masonry or water. Which is right? Answer: Your friend is right. The pier, A, would offer less resistance; B would cause eddies, and would not allow the water to fill in behind it promptly and thus would have less pressure behind it to balance that in front. The laws of resistance are the same in this case as with floating bodies. Notice the behavior of a vessel with a full run and compare it with a similar craft with a fine after body.

G. W. D. says: A friend says that it will take less power to draw a given weight, or wagon load, by a long rope than by a short one; one end is to be attached like a trace to the wagon, and the power applied at the other end of the rope; I differ with him. Who is right? Answer: The power required to move the vehicle will be the same, no matter whether the rope used is long or short. In some cases, a long rope is advantageous by reason of its elasticity, as it ensures a gradual application of the power to the load.

F. H. F. asks: What are the colors commonly used by draftsmen in machine and other drawings, and of what are they composed? Answer: India ink is used by draftsmen for black lines, and, for other tints, the ordinary water colors, sold in the stores.

T. C. J. says: 1. In Peterson's "Familiar Science," I find this statement: "Captain Scoresby saw the reflection of his father's ship, Fame, which was then 17 miles below the horizon, and 30 miles distant." How is this? I did not think the earth's curvature was so great. Will some one give a simple rule for finding the earth's curvature for any given distance? 2. Would I be safe in buying the instrument described in the enclosed advertisement, and do you know the men to be reliable? Answer: The thumb rule for determining the earth's curvature is: two thirds the square of the given distance in miles equals the curvature in feet. Thus, for thirty miles, two thirds the square is 600. This result is of course an approximation, and is about seven feet too great. The problem can be readily worked out trigonometrically with accuracy. In the matter of wasting a dollar, you need no advice.

J. R. M. finds difficulty in making liquid rubber with unvulcanized rubber obtained from a dentist. Answer: Dentist's rubber is generally prepared in some way or other. Try pure native rubber.

T. R. asks for a colorless adhesive substance for paper. Answer: Try dextrin or potato starch; it will dry well and is very transparent.

H. B. asks for Dr. Bird's method of preparing urine for microscopical examination, and for the remedies for an undue quantity of lime salts. He should consult Dr. Golding Bird's work on the subject, to be found in any good medical library.

J. C. says that hot caustic potash will ruin old dry paint brushes, but that caustic soda, used in a cold solution, will do. They should not be immersed above the string.

R. H. asks how to clean a set of drawing instruments, the steel of which has become rusted. Answer: If you do not want to have them cleaned by a good mechanic, who will fine-file and oil them, you may polish them yourself with fine emery paper, crocus and oil.

J. S. A. asks: What is the most compact battery or electrical instrument that an amateur could make, or get, to heat fine platinum wire red hot? Answer: An ordinary Grove battery will do to heat up a short length of fine wire. We are constantly publishing practical papers on electricity.

C. J. F. says: We are building a school house, and the mason told us that the mortar would freeze dry in three days. He put on the scratch coat three weeks ago, and it is frozen as hard as ever. What we want to know is: Will it freeze dry or not? If so, hat is the philosophy of it? How can the ice that is in e mortar get out without thawing? Answer: In the rly fall, in freezing weather, a building is sometimes left exposed with the scratch coat of plastering not quite dry, because it is found to dry very rapidly in frosty weather, and the water is all dried out of it before it has a chance to freeze. But when plastering has been really frozen, it must thaw, and disintegrate the mortar in thawing, which will show itself in the small flakes that appear on its surface.

W. R. asks how to prevent lead pencil drawings from smearing. Answer: Try an application of new milk to the drawing, having previously stretched the latter tight on a board with drawing pins.

C. F. B. can gild picture frames with the gold size described in H. G. B.'s answer to W. H. C., in this column.

B. sends some small stones from Idaho, requests us to examine them, state what they are, and their value. Answer: The specimens are all chalcedony, an uncrystallized variety of quartz. When flesh colored, it is valued in jewelry under the name of cornelian; and when banded, it is called agate. But the gray and yellow pebbles are seldom used by the lapidary

D. promises to send a subscription, and says: On a railroad, there is a train consisting of an engine, tender, and three platform cars. At each end of the cars there is a man: and when the train shall have reached a speed of a mile in four minutes, the men shall run in opposite directions, and each shall jump, respectively, off the end of the train opposite to that whence he started. One of them, of course, jumps with, and the other against, the motion of the train. What position will each maintain, and which will receive the greatest concussion? Answer: The man running in the same direction with the train will have a horizontal velocity, relative to the ground, equal to the sum of his own speed and that of the train. The other will have a velocity on striking equal to the difference of the two speeds. If the men run with a velocity equal to that of the train, the first will strike the ground with a horizontal velocity of 30 miles per hour; the second will have no horizontal motion. The first will receive the greater shock, but, striking with his face toward the direction in which he moves, will be best prepared to meet it. If the second strike the ground in a perfectly vertical position there will be no tendency to destroy his equilibrium, if he has moved with the velocity stated. Send along your subscription.

H. C. S. asks for some good cement to stick rubber and wood together. Will good strong hot glue do it? Answer: Yes, especially if the wood is well painted with white lead in oil.

J. H. H. asks: Should the mud drum of a boiler or boilers be covered up or exposed to the fire? Is there any danger if the mud drum is exposed to the fire? Answer: A mud drum exposed to the heat of furnace gases is as liable to injury and explosion as a boiler would be under similar conditions. Never allow a mud drum to be exposed to the action of the gases of combustion until, by contact with the heating surfaces of the boiler, they have become reduced greatly in temperature. Set mud drums so that they shall be in the coolest part of the flue, if possible. If necessarily placed where flame might reach them, protect them by a covering.

J. S. J. asks the difference between a high and low pressure engine, and what is vacuum and how formed. What is the best rule for computing the horse power of steam boilers? Answer: In the low pressure engine the steam is condensed and the water used again in the boiler. In the high pressure engine the exhaust steam is not condensed, but is discharged into the air. The locomotive is an example of the high pressure engine; the large steamboat engine, of the low pressure.—A vacuum exists where the pressure of the air is removed. If you apply your mouth to a bottle and suck out the air, then you have a vacuum in the bottle. The nominal horse power has ceased to be any measure of the dimensions of a boiler: and the best course is to consider only the water evaporated. A cubic foot of water converted into steam in an hour was considered by James Watt as equivalent to 1 horse power; and this, he found, could be done in his day by 8 square feet of heating surface.

L. S. W. says: I have a well under my house, and the water has lately became so bad that we cannot use it for any purpose, The well is 36 feet deep, and is walled with stone, with a white oak pump. There are some willow and other trees close to the house, the roots of which penetrate through to the water. Answer: A remedy is a frequent and thorough cleaning out of your well. Tree roots are always troublesome in the vicinity of wells

H. C. D. says: Mentioning to an engineer that I had ordered a heater and steam pump for my boiler, he informed me that a boiler inspector had told him that "the use of a heater which uses the exhaust by passing it direct through the water to be heated, would communicate so much oil to the feed water as to cause a great deal of injury to the boiler, by forming a thick oily substance in the bottom, and thereby burning the boiler." Now, if the heater and filter perform what they profess, how can sufficient dirt and oil pass through to form this sediment? But the inspector ought to know. Answer: Some kinds of deposits in steam boilers are very liable to unite with the oily matter carried into the boiler with the feed water, and to give rise to danger of explosion and burning of the iron. Careful inspection will usually determine whether, in any given case, this may occur. An effective filter would prevent such danger.

G. W. J. says: We are out of rain water in our vicinity. What can we put in other water to make it agreeable for toilet use? Answer: Couldn't tell without testing the water.

A. & Y. say: We have a yacht of 35 feet length, 8 feet beam, and 4 feet hold. We propose to put in a 4½ horse power double engine, and to work it under 90 lbs. pressure. About what sized stern wheel do we require, and of what pitch, and at what speed will the boat run? Answer: We have not sufficient data upon which to base our estimate. What is the size of your 4½ horse power engine? Is your wheel a western stern paddle wheel, or is it a screw, as we should infer from the request to give the pitch? Have you sufficient boiler power to keep up 90 lbs. steam? Has the boat full lines, or has it a fine bow and a well shaped run? To be able to predict its performance with accuracy, a consulting engineer would need the body and shear plans of the boat, as well as the particulars above demanded, as the solution of such a problem calls for the exercise of an experienced judgment as well as of mathematical and professional skill. With the data above asked, we shall probably be able to predict pretty nearly, however, the performance of the projected yacht.

A. K. S. asks: Does the hardening of steel make a chemical change in it? If so, what is the change so made? Is the change molecular? If so how, or in what manner is it produced? Answer: The immediate cause of the hardening of steel is still a subject of dispute among chemists. The majority side in favor of the theory that there is a molecular change produced when iron is converted into steel.

G. W. D. says: Is there such a thing as a reliable weather table, based upon the changes of the moon in its quarters? If so, who is it by? Is there a Sir John Herschel's weather table? If there is, where can I get it? Answer: Some years since the *Farmer's Almanac* published what was called a "Weather Table, by Sir W. Herschel," wholly without authority from Sir W. Herschel, and probably without any scientific basis.

H. H. T. asks: 1. Does the center of a revolving shaft turn? Answer: Yes.—2. Is a steam gage as correct at ten feet from the boiler as at one foot? Answer: Yes, if not placed on the steam pipe or where the motion of the steam may influence it.—3. Supposing a steam gage to show 10 pounds too light, would there have to be a pressure of 10 pounds before the pointer would start? Answer: Sometimes, but not usually.

S. P. asks: What kind of a solution do silver platers use to dip their burnishers in when they burnish their work? Answer: Various mixtures are employed for this purpose. ½ lb. prepared chalk, ¼ oz. camphor, 1 oz. each aqua ammonia and alcohol, 3 ozs. benzine, well mixed and allowed to dry before burnishing, is a good preparation. A solution of cyanide of silver is also used by some silver platers; also several acids. The whole subject is well explained in hand books for electro platers.

D. M. S. says: Does a hole through a bar of iron four feet long, for instance a crow bar, increase the strength? Answer: A solid bar is stronger than a hollow bar, the circumference of both being the same. But if you put the same amount of metal that the solid bar contains into the form of a hollow bar, such hollow bar will be larger in circumference and will be stronger than the solid bar.

F. A. G. says: 1. I have a hot water tank connected, by means of two pieces of lead pipe, with a hollow front in my cooking range. The lead pipes are each twenty inches long. The ends that pass through the bottom of tank are nine inches higher than the others, which are connected with the range. The trouble lies here: A very hot fire causes the water to boil in the tank so as to make a noise which is very annoying to hear. Will this noise be lessened by lengthening the pipes and setting the tank further from the stove? Answer: The annoyance might be somewhat abated by using long pipes, but it would be at the expense of efficiency in the heating apparatus. The division of the current of steam by carrying it into the tank through a number of smaller pipes would be very likely to prove more satisfactory. 2. Can I convey the steam from the tank through a small pipe, either to the fire box, the stove pipe or the chimney, directly, without its forming creosote? Answer: Yes.

J. W. D. says: 1. I had an occasion to cover a portable boiler, to protect it from the air, and for convenience I boarded it up and filled in with sawdust. The dust was mixed poplar and sweet gum, and had lain in bulk 8 or 10 days. When I raised steam in the boiler, the vapor from the sawdust smelt like that from a whiskey still. Was there any alcohol in it? Answer: The vapor very probably contained some alcohol resulting from fermentation of the sap contained in the wood.—2. Ice melted very slowly becomes porous, indicating that it was not a homogeneous body, and that one part melted at a lower temperature than another. How is this? Answer: Ice always melts at a temperature of 32° Fahrenheit. The fact noted indicates no exception to this law of nature, but simply that the disintegration of the ice crystals happened to produce greater porosity at one point than another.

S. H. says: I have a kitchen range fitted with a water back which looks very weak, and knowing the disastrous results of several explosions of such boilers lately, I thought, if a boiler made of a coil of pipe at the back of the fire was practicable, it would have the advantage of safety. My plumber shakes his head at it. I cannot see anything wrong about it myself, but not being a mechanic I am no judge. If the idea is at all practicable, any improvements you would be kind enough to suggest would be acceptable. Answer: The objection to your plan for a water back for your stove would be the difficulty of securing a good circulation of water and ready escape for the steam formed.

A. H. G. says: I notice, by my glass water gage, that in the morning, when I get up steam, the water is one inch lower in the tube than when I stopped at night. After steam is raised, it does not rise to the same point, but only rises a quarter of an inch. This puzzles me. The blow off does not leak, nor is there any leak about the boiler. Answer: It puzzles us, also. The data offered are not sufficient to justify the expression of an opinion.

J. O. says: I have a dam on a springy, sandy bottom. Can it be destroyed by throwing quicksilver into the water, and what amount would do it? Does the density of the bottom or pond side increase in the same manner as water of the ocean, and what would be the probable difference in density between the pond and tail water at a depth of 8 feet? Answer: Your mill dam is in no danger from any amount of quicksilver that you will be able to purchase in the market. The density of water increases very slowly with its depth, and the increase would be quite inappreciable in the case mentioned. A pressure of one hundred pounds per square inch only compresses water to the extent of about thirty-five one-hundred-thousandths. To compress 1,000 cubic feet of water into a volume of 999 cubic feet requires a pressure of about 300 pounds per square inch, or a superincumbent column of water about 700 feet in hight.

G. L. K. asks: What size of opening would be required to give 5 horse power from a boiler under a pressure of 50 pounds per square inch, and what size of opening would be required for a 7·5 horse power at 50 pounds and at 60 pounds per square inch? Answer: The size of opening required to deliver steam to an engine depends largely upon the amount of pressure that it is allowable to sacrifice. Generally good builders make their passages and pipes at least one tenth the area of the steam piston, with high speed of piston. With a long and crooked pipe, a still larger proportion is often adopted.

M. D. C. says: Your answer to F. H. N., in No. 22, Vol. XXVII. seems wrong to me. I wish to say that, if you drop a stone of a given weight into a body of water, waves will be produced a certain distance, and a second stone of the same size dropped at the same time, will not extend the undulations any farther. Is not this analogous to the question asked? I was at the first Jubilee held in Boston, and I claim that Parepa Rosa's voice could be heard farther than the singing of the entire chorus, because it was the most powerful of any and extended farther. Answer: The distance which a pure sound, a musical note as we usually term it, can be heard increases in the proportion of the square root of the intensity or loudness. We heard Parepa Rosa and the choruses on the occasion referred to, and our reply seems justified by observation. Sounds may, however, either reinforce each other or they may extinguish each other. Examples of the latter case are not frequently noticed, but we daily use sounding boards and other expedients illustrating the latter. See works on acoustics.

L. A. H. encloses a mineral specimen from Kansas, and asks what it is? Answer: An indurated plastic clay (neither loam nor marl) of very fine texture and slightly colored by oxide of iron.

J. W. M. says: I have seen at different times reports of copper tools, that were used in ancient times, being found. Said tools, it was stated, were tempered and were found to compare to those in use at the present time, that are made of steel. Can you inform me whether these copper tools were merely hardened at the ends or throughout, and where any can be found on exhibition? Answer: The copper tools of the Incas appear to have been throughout of the same hardness. One brought to this country from Cuenca by Professor Orton is now in the University of Rochester; but there is doubtless a number of them in the Smithsonian Institute.

In answer to H. & B., query 3, page 893, volume XXVII., allow me to say that there is now a pump at work at Fort Whipple, Va., which draws water from a spring at a distance from the pump, horizontally, of 900 feet; and in a vertical direction, of 68 feet. The pump is worked by horse power, and as soon as the weather moderates will supply the Fort with all the water required by 100 men and twenty animals.—C. C. W.

W. E. T. sends a sample of seme mineral and would like to know what it is composed of and could be profitably used for. Answer: It is a very finely comminuted siliceous rock, with a small percentage of alumina, and evidently a result of decomposition, like kaolin. It would make an excellent polishing material.

A. M. S. sends a stone and asks what it is. Answer: It is massive iron pyrites, important, not for the iron, but as a source of sulphur and copperas.

T. McG. encloses a small piece of mineral, and asks for our opinion of it. Answer: It is iron pyrites.

G. R. E. G. encloses minerals and says: Please tell me their value and qualitative and quantitative character. No. 1: Some of the substance has been treated alone as well as with soda and with borax, before the blowpipe on charcoal. It has been tried in dilute, and also in C. P. sulphuric, nitric and muriatic acids, separately and also with their binary and tertiary combinations. It has been roasted and then subjected to the above tests, and still no result except a brownish brittle substance, slightly subject to the magnet. Some call it brown hematite; some say it is the same metal affected or impregnated with bitumen, and that its presence on the surface is indicative of coal formation in the vicinity; while others think it some compound of silex. Number 3 is granite. Answer: No. 1 is unmistakably brown hematite, or more correctly limonite. No. 3. is syenite, not granite.

B. B. R., writing from Ill., says that the temperature there has been as low as 23° below zero, and distillers' mashes go into the fermenting tubs at 106°, instead of from 86° to 92°, during the winter season.

S. F. says: I have read different ways, in the SCIENTIFIC AMERICAN, of preparing skeletons, the last one is good. It is to put the animal in a sieve and place it in a creek where the water can run through the sieve for three or four months; but I cannot place an animal two or three miles away from home for three or four months, so I tried another way, and found it good. I skinned and cleaned the animal without injuring any of the bones. (Of large animals, such as dogs, the flesh may be cut from the bones.) Then I boiled it soft in pure water and then took off as much of the flesh as I could; then I boiled it again in a mixture of two ounces of ordinary brown soap and five ounces of ordinary wash soda to one gallon of water, for about four hours; then I took the bones out of the mixture and placed them in another clean vessel and cleansed them off with boiling water.

G. H. says that J. H. R. should coat his skiff with boiled linseed oil.

A. J., page 10, current volume, asks how to load shot guns so as to throw the shot close. If he decreases the charge of powder or increases the charge of shot, the desired effect will be reached. The shot should also be rammed very little.—L. E. S.

G. H. says B. F., query 14, page 10, should repair the lead cistern with 2 parts black pitch and one part of rosin, make them into a paste, and coat the injured places. White lead with sand or ashes may also be used to stop the leaks in lead cisterns.

To C. R., page 10, Vol. XXVIII.—Don't use cloth for your fire board. It is cheaper and better to get from any store or printing office two or three sheets of the thickest wrapping paper, but empty flour sacks will do, and it matters not if they have been used and are wrinkled; glue together neatly a sufficient number of sheets to cover your fireboard and extend an inch or two beyond the edges. When the seams are dry, wet the entire sheet well with a sponge or brush, and whilst in that condition paste or glue it hurriedly to the edges or back of your fireboard. When dry, it will be as tight and smooth as a drum head; then apply the paste to the ornamental paper and lay it on evenly. A frame of four slats, three inches wide, is better than solid board, and any number of plies of paper can be put upon it.—T. M., of Pa.

To B. W. & Co., page 10, Vol. XXVIII.—Paste made by soaking gum tragacanth in water will stick on bright tin. The older the paste is, the better it will stick.—T. M., of Pa.

G. H. says: W. & Co., query 7, page 10, should coat the tin with boiling varnish and pitch, mixed with any desirable color; this mixture will adhere to bright tin.

W. H. C., query 8, page 10, can gild walnut wood as follows: Put on two or three coats of shellac or spirit varnish; and when dry, size the lines to be gilded with good gold size and, when sufficiently dry or tacky, apply your gold leaf with a camel's hair tip, and smooth off with soft silk handkerchief.—H. G. B.

G. H. says: Z., query 5, page 10, can remove the taste of kerosene by putting a few pounds of burned lime into the vessel, adding water, and closing the bun holes; shake the vessel till the lime has cooled, then cleanse the same with cold, and lastly with hot, water.

To T., query 21, page 10, current volume.—To dovetail a beveled box, first cut your board to the bevel at which you want to make your hopper; then set your bevel square to the end of the piece, and cut the bottom of your board to the same angle; then take your try square, and square across the board from the inside, letting the blade of the square lay flat on the level of the board, and it will give you the exact shoulder, inside and out, and it will fit well.—J. S. B.

To sink a well without taking out the brick: from the inside of the brick, slant out, down, two feet; when you are even with the outside, dig down as before. In laying up, when you come to the slanting part, take a trowel and remove the dirt as fast as you want to put in a brick.—E. W. B.

To A. J., query 4, page 10.—The rule for preventing shot from scattering is: Twice as much shot as powder (by measure, not weight), but you must suit your charge to the gun. Do not ram down the shot too much; only make sure the wad is down. For longer or shorter range, change the size of the shot, not the charge of the powder.—N. A. K.

J. M. sends minerals and asks what they are, and if they are of any value, or indicate the existence of metallic ores in their locality. Answer: The specimens are quartz crystal and fragments with small crystals of iron pyrites or "fool's gold." They do not necessarily indicate the presence of metallic ores.

To H. B., query 6, page 378, Volume XXVII. Forge the strip of steel into the desired shape, heat it to a cherry red, and fuse cyanide of potassium on its cutting edge. Return it to the fire, heat it to a cherry red, and immerse in lukewarm water until cool. Take care not to inhale the vapor of the cyanide of potassium. The degree of hardness can be acquired by practice in fusing the cyanide. Do not heat the steel enough to warp it. I found this plan succeed well with thin pieces of steel.—F. A. K., of Pa.

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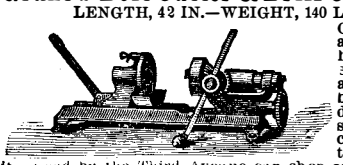

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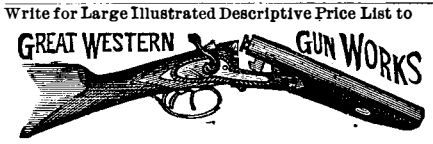

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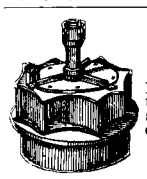

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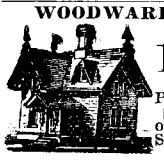

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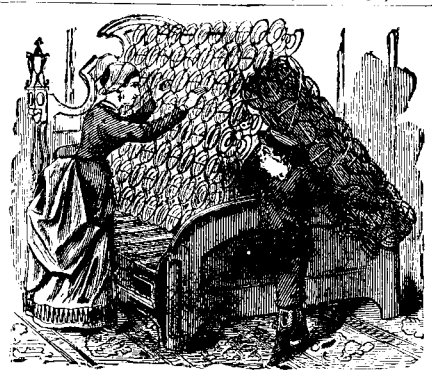

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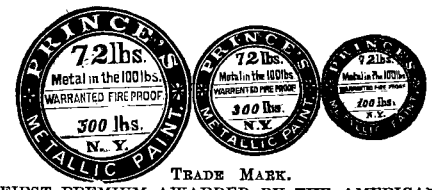

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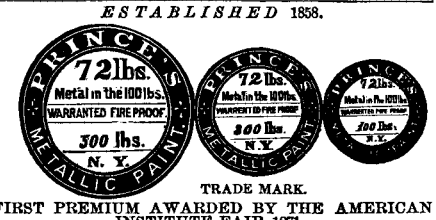

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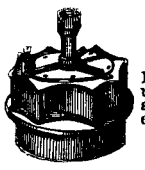

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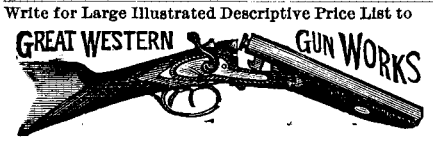

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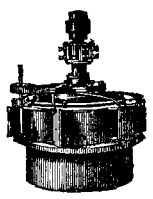

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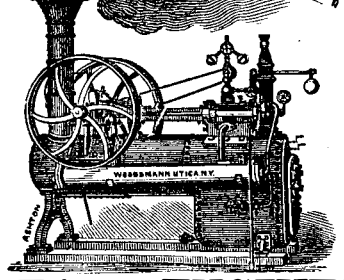

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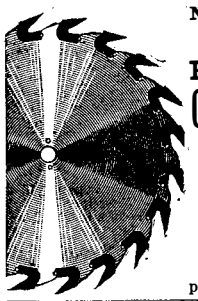

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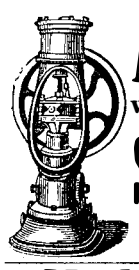

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